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Engineering and

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director

HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britian, and British Possessions $3.00. U.S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, July 5, 1922 No. 27

Motor Freight Transport Will Succeed to the Extent That People Demand it

It was inevitable that more than one of the authorities addressing the Canadian Good Roads Association at its recent convention should at least touch upon the question which has come very much to the fore in the United States comparatively recently—the use being made of the state and national hard-surface routes for the transportation of local freight. The position usually taken is that this growing traffic is a menace to the railroads and to the highways, and figures are given showing the amount of freight handled on certain routes as compared with railway haulage. In one case, the road through New Jersey from New York to Philadelphia, it is stated on high authority that as much freight is transported over the highway as is carried on the five railroad lines connecting the two cities. "Local" freight is referred to, of course.

There is perhaps another point of view, quite different from the one which would dictate a policy of suppression or at least discouragement of this growing traffic by means of severe limitations of loads and other restrictive measures. The fact that this traffic is not burdened with the overhead costs that go with a private right-of-way, and is not even directly concerned with the maintenance of its roadbed is not necessarily an argument against it. The use of the public highways so reduce the overhead that a much lower freight rate is possible in conjunction with a much more intimate service. But no one will attempt to deny the existence of a further overhead chargeable to the highway which corresponds to the tracks and right-of-way of the railroads. This, however, is absorbed by the public as a whole and is paid for in taxes, the motors taking their share by the payment of licenses in addition.

Our point is that in the last analysis the public pays for the service it receives, whether in the form of roads or railways, and if the service given by the new method is more convenient than that of the old, it is more than probable that there will be a demand for its continuance, in which case the problem will simply become one of providing in the best and most efficient manner possible for the new method of transport.

Change will come, and the history of the past shows that though it may for a time be delayed by reluctance to admit its inevitability and by the fact that financial interests would be adversely affected, change is like time—it goes ahead, whether we will or no.

Vancouver Prepares for Power Shortage

The Vancouver City Council recently appointed a committee whose duty is the recommendation to the council of an engineer to conduct investigations into the general water power situation in the vicinity of the city. Interviewed by the Contract Record, Mayor Tisdall explained that the city, which at present obtains all its power from the plants owned and operated by the British Columbia Electric Railway Co. Ltd., has the right under the charter to generate and supply its own power. There is no intention at present to proceed with any actual development work, the Mayor proceeded, but a careful investigation will be made of all possible power sites, and as far as possible the development rights will be secured for use when required.

Asked if there was any anticipation of a shortage in the power supply from the present sources in the near future, Mayor Tisdall said that this is not the case, the city's action being simply one of precaution, and primarily concerned with the still distant future.

The B. C. Electric Railway Co. Ltd., supplies power to the city and district from two main hydro-electric developments, the Buntzen and Stave Lake plants. The total horse-power of turbines, including the fourth unit at present being installed at Stave Lake, will approximate 155,000 h.p., which serves the requirements not only of Vancouver, but of the suburban municipalities, as well as the city of New Westminster and the towns of the lower Fraser Valley. The company's policy, it is understood, has been throughout its history that of keeping a safe margin of developed power in advance of the requirements. The years 1912 and 1913 are the only ones in which any difficulty was experienced in thus keeping up, and these two years witnessed an abnormal expansion that is hardly likely to be repeated. Present conditions are somewhat difficult of analysis as the power load fluctuates considerably in certain industries and does not bear any fixed proportion to the connected load. It is believed that with the installation of the present fourth unit at the Stave Lake plant, development on the two projects will be complete, but it is understood that a second site exists on the Stave River at which the tail water from the upper site could be made use of.

Difficulties in Sewer Tunnelling in Wet, Unstable Ground

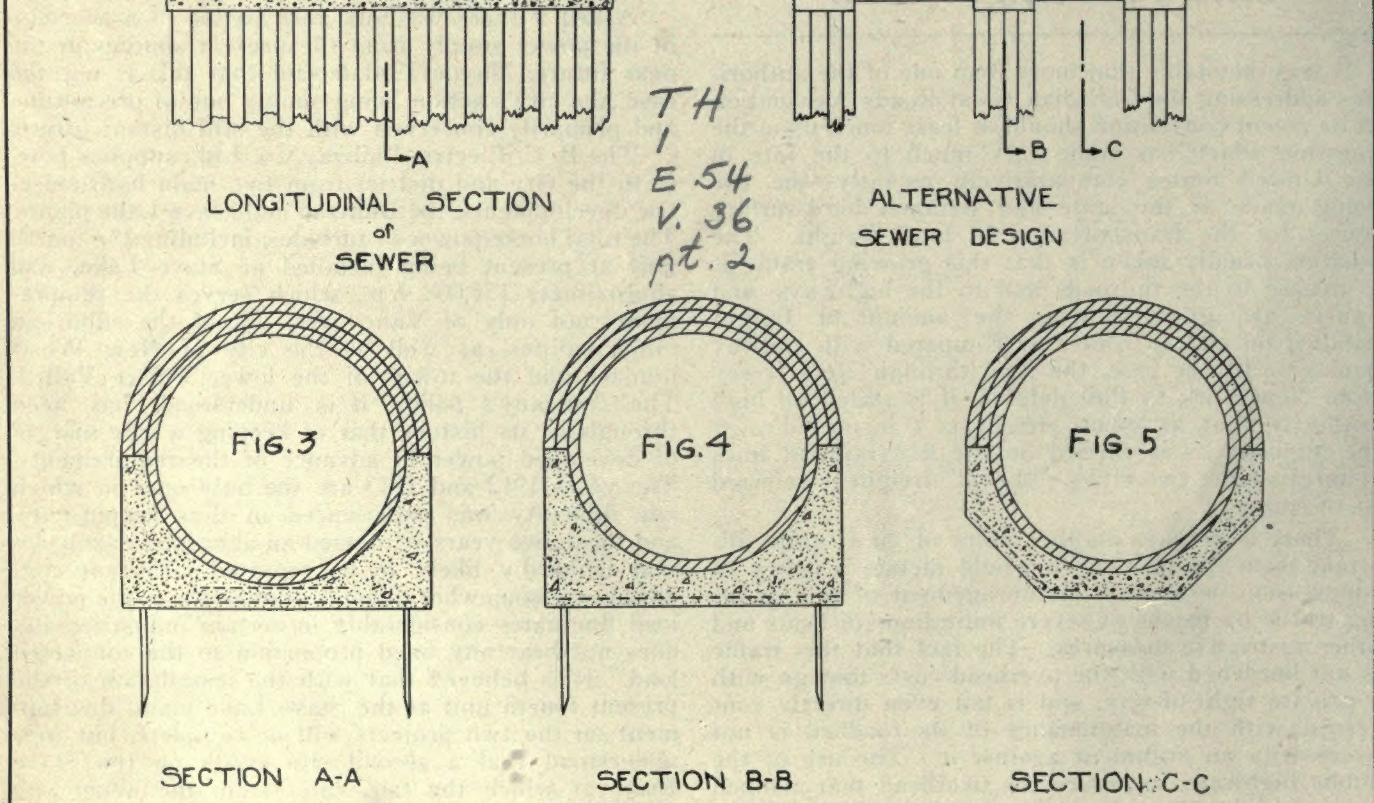
Trouble With Quicksand in Tunnels is Frequently Experienced but Seldom Understood—Procedure to Relieve Uneven Pressure—Open Cut Repairs Should not be Made to Air Tunnels

By W. G. CAMERON, B.A.Sc.
Assistant Engineer, Sewer Section, Works Department, Toronto

Since the recent article on compressed air appeared in the Contract Record, (April 26, P. 365) a very good illustration of one of the points brought out has occurred which would be interesting to discuss at the present time, especially as it is understood that several pieces of work of a similar nature and under similar conditions are under consideration in various places.

The ground in question was of a loose, wet, fine, sandy nature, or, as it might be described, quicksand. This after all is but a fine wet sand which for the moment is fluid on account of the presence of water in greater volume than the cubic measure of the voids. Of course, when under pressure, the grains are forced together and the sand becomes as solid as sand in any other condition.

A tunnel was contemplated through ground of this nature and it was decided that it would be econ-



Sewer designs for wet ground

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omical to use compressed air during the construction. The locks were built in open cut. This open cut was heavily timbered and tongue and grooved sheeting was used, but even with this precaution, the timber settled until at the surface of the ground it looked like a German Dachshund.

Considerable trouble was met with as the work progressed owing to the nature of the ground and to local overhead utilities. The air escaped so rapidly that sometimes the work had to be shut down every other day to allow the ground to settle. Overhead utilities were rebuilt to one side and extra fill was heaped over the tunnel, but even with all these aids, it was difficult to completely dry the tunnel. The lower portion was frequently quite wet. It may be assumed that a small quantity of sand escaped from under the last section of lining each time a new length was excavated. As the lining was circular in design, the importance of this will be seen later.

Needle-beam timbering was used throughout. The brick lining was commenced at the bottom and as it was completed towards the crown, the supports from the needle-beam were removed. In this way the full weight of the overhead ground was allowed to rest on the lining as soon as completed and the needle-beam removed. The tendency then was for the ground at the springing line to be forced to fill up the vacant places underneath mentioned above, thus allowing the green lining to spread and crack. But when these adjustments had taken place, there was no further movement apparent and the only thing that could injure it further would be undermining or unequal pressure.

Pressure Released by Open Cut

The tunnel was completed and shortly afterwards a shaft for local purposes was sunk where this spreading had taken place. This removed the pressure from a small section. With the pressure removed, the sand then became liquid and when the excavation had reached the springing line, 23 odd bags of cement were dropped into the bottom and on one side of the lining only. This and the lining were used as a foundation, the shaft was lined to the surface some 40 ft. and the surplus excavation filled in. The tunnel lining commenced to spread again on each side of the shaft. It was decided that a repair would have to be undertaken and this repair was made in open cut and when the excavation was partly completed, was allowed to stand for some time for lack of material. Steel sheet piling was used when the sand became wet and this was driven several feet below grade and left in place. But, of course, this when driven at the end through the old brick lining still further released the pressure which the open-cutting had already begun to release, so that the sand now became liquid and spurted up some distance above the invert. The moral of this would appear to be to never repair in open cut a tunnel that has been built in compressed air. See the illustration for a suggested design to be used in ground of this nature.

Sewer Designs for Wet Ground

In the sketches it will be noticed that sheet piling is used under the flat bottom. Too much importance cannot be placed on this piling, for as ground of this nature folds under varying uneven pressures, the thrust will be down under the walls of the lining and up in the centre under the invert. The folding will depend largely on the wide variation in this class of ground, the condition of which varies with the amount of water present and on the fineness of the sand as well as on the pressure. The piling then not only assists in taking the uneven weight at these points, but also prevents the contained ground from folding, therefore relieving the upward thrust.

When piers are used, they must be built strong enough to allow the section between two piers to bridge over if necessary. It is also noted that piling is used only on the sides of the piers. It may be necessary to drive this piling all around the piers. Again it is noted that decking is not used under the square bottom. In an air tunnel, the ground should be dry and decking is therefore superfluous. Ground of this nature, too, where wet one year, may be thoroughly drained the next, so that the decking will decay and leave a space under the lining. It might be advisable that, where decking is desired, sheet metal or some other waterproofing be used. The latter would keep the masonry dry while setting and would also allow the masonry to take up any uneven spaces under it. This condition of ground is not generally understood and where elaborate precautions are taken, some small extra would as often as not be adequate.

Motor Freight Haulage

Gasoline Propelled Vehicles Have Taken Local Freight Traffic From the Railroads—Should Help Defray Road Upkeep

By HON. J. P. HARTMAN, Seattle, Wash.
Before the Canadian Good Roads Association

The King's Highway is supposed to be for the free use of anyone who may choose to use it. When this principle was adopted the "whiz" wagon was not dreamed of. But, in the last few years we see gasoline vehicle lines paralleling railroad lines, the one occupying a free track and right of way without upkeep charge or taxes which the other is compelled to help build and at the same time build and maintain its own road bed and way and in addition pay a tax annually thereon as well as upon its rolling stock, and be publicly regulated while the other goes practically free. These public conveyors on highways have robbed the railway of practically all their well paying short-haul freight, out of the larger cities particularly, and paralyzed the profitable suburban travel which was enjoyed by the railroads to a very large degree. This condition cannot be changed but if one class of publicly controlled utilities shall be called upon to sacrifice its business, then those who take it should compensate the public by the lower rate or pay for a goodly portion of the cost and upkeep of the highway which is used. This conclusion is sound economically and the principle must prevail.

May I give some figures relating to a dairy district in Washington where I was one of the producers. Twenty-five years ago, when the roads were all mud during a moist season of six or seven months, it was difficult to get the milk to the railway station to ship it to the two principal cities. The freight charge was five cents per gallon for the rail haulage. Later on an electric interurban line passed through that dairy district and as it could stop often, took the business away from the railroads and charged one

(Continued on page 677)

Estimating the Cost of Excavating

The Factors Involved and Production Units Applying Thereto—Details of the Method of Computing an Estimate of Excavating Operations

By CHAS. F. DINGMAN, M. Am. Soc. C.E.

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Because of the apparent simplicity of the operation of excavating in most building construction, it is not usual to give as much consideration to estimating the cost as the importance of this item would warrant.

There are so many factors which affect the cost of excavation that it is really one of the most difficult parts of building work to estimate accurately. Computing the quantity of material to be excavated is a comparatively simple matter, but consideration must be given to all of the following factors:—

Care must be taken to include the dimension from outside to outside of the spread of footings and also from the top of the grade to the underside of the cellar floor construction. Footing trenches, pierholes and other excavations extending below the general cellar excavation should be figured separately, under proper headings, and individual prices computed for each class of excavation.

Where the nature of the soil is such that the banks will not retain their vertical position without support, proper allowance must be made for bracing. With shallow excavations, or where building lines or other constructions do not interfere, it will usually be found cheaper to slope the banks than to brace them. A discussion of the cost of bracing will be given further on.

If the banks are to be sloped it will be necessary to figure the cost of excavating a prism of earth all around the excavation, the dimensions of the prism being determined by the depth of the excavation and the angle of repose of the material to be excavated. The volume of this prism will also have to be added to the quantity of backfilling.

The angle of repose, or the slope which the material will maintain without further sliding, is approximately as follows:—

	Wet	Dry
Sand	3 degrees	33 degrees
Loam	27 degrees	35 degrees
Clay	17 degrees	45 degrees

These figures are, of course, subject to as wide a variation as there are variations in the soil formation at different places. Determination of the angle for any particular kind of earth can only be made by observation, and the estimator will usually make it his business to be sufficiently conversant with the soils in his vicinity to approximate the angle of repose in any instance, or he will be able to get that information from someone who is familiar with local conditions.

In fairly firm soils, footing and pier excavations can usually be figured as the net width of the bottom course, without allowance for forms, but sufficient space must be allowed for footing forms in unstable soils and for wall or pier forms in all cases where they will be used. This allowance is usually taken as one foot from the face of the wall.

Quantities Excavated by Hand

Where the area to be excavated is comparatively small and the depth of the cut is not over nine or ten feet, the shovelling will usually be done entirely by hand and the following figures represent the amount of earth that can be loosened and shovelled out per man per hour:—

	Dry	Wet
Sand or loam,	1.12 cu. yd.	0.70 cu. yd.
Ordinary medium soil,	0.70 cu. yd.	0.40 cu. yd.
Heavy soil or clay,	0.45 cu. yd.	0.30 cu. yd.
Hard pan,	0.40 cu. yd.	0.25 cu. yd.

In very shallow footing trenches the production will vary but slightly from the figures given above, but for deeper trenches and for deep and narrow pier pits the production will only equal the following percentages of those quantities:—

	Trenches	Pier Pits
Depth not over 6 feet,	77%	73%
Depth 6 to 10 feet,	48%	45%
Depth 10 to 14 feet,	33%	30%

Where the area to be excavated is comparatively large, it will usually be found economical to use a plow to loosen up the earth and prepare it for the shovellers, though they will occasionally have to do some small amount of additional picking.

One plow, drawn by two horses, driven by one man with one helper can loosen

35 cu. yds. of ordinary medium soil per hour.
20 cu. yds. of heavy soil or clay per hour.
or, with an extra driver and pair of horses,
20 cu. yds. of very tough clay per hour.

When the earth has been broken by the plow the shovellers should average the following production:—

Ordinary medium soil,	1.22 cu. yds. per hour
Heavy soil or clay,	0.95 cu. yds. per hour
Hard pan,	0.85 cu. yds. per hour

The earth shovelled out will, of course, have to be moved away by barrows, carts, motor trucks, cableway or other means. Since the first three are the most usual for building construction, they are the only ones that will be considered in any detail here.

The general building contractor will, as a rule, seek either unit or lump-sum sub bids from excavating contractors when the work to be done is unusually complicated, so the matter contained in this article will be ample to enable him to estimate on any piece of work.

Disposal of Spoil

Wheelbarrows are not usually economical except for moving over very short distances, and the amount which one man can transport per 100 feet per hour is as follows:—

	Dry	Wet
Sand or loam,	1.8 cu. yd.	1.6 cu. yd.
Ordinary medium soil,	1.7 cu. yd.	1.4 cu. yd.
Heavy soil or clay,	1.5 cu. yd.	1.2 cu. yd.
Hard pan,	1.4 cu. yd.	1.1 cu. yd.

A two-horse cart, having a capacity of 1.50 cubic yards of loose material, which equals about 1.20 cubic yards measured before excavating, can travel at the rate of about two miles per hour when loaded and three miles per hour returning; five minutes must be allowed an each trip for dumping and turning and ten minutes for loading. This quantity is for fairly good roads; if the roads to be traversed are poor, the quantity hauled must be reduced in proportion.

Where the grade of the ramp out of the excavation is very steep it will usually be necessary to keep a helper or "snatch" team of horses, with driver, on hand to assist the other teams. The cost of this additional team and driver will be distributed over the production of the other teams and will become less per cubic yard as the production of the other teams increase.

In most instances it will be necessary to keep a man at the dump to spread the excavated material as it arrives. He can usually spread about ten cubic yards per hour. If material is delivered at a more rapid rate than that, an additional man will be required. In other instances no provision will need to be made for spreading at the dump, but this should always be investigated and considered when making an estimate.

Excavations with Scrapers

Comparatively shallow excavations in sand, gravel or loose soil can often be handled very economically by means of scrapers, particularly if the excavated material may be disposed of within a very short distance. The maximum distance for economical use of ordinary drag-scrapers is 200 feet, and for wheel-scrapers it is 500 feet.

Since the drag scraper will carry four cubic feet of material (the nominal capacity is five cubic feet) and the team will average a speed of two miles per hour or 176 feet per minute, it follows that the time cost of moving a cubic yard of earth a distance of 200 feet, allowing 25 feet at each end for turning and ½ minute per trip for loading and dumping the scraper, will be as follows:—

27 divided by 4=6.75 trips per cubic yard.
225 divided by 176=1.28 minutes per trip each way, or

2.56 minutes per round trip, plus ½ minute for loading and dumping, equals a total of 3.06 minutes per trip; therefore, 6.75 trips at 3.06 minutes equals 20.65 minutes of team time per cubic yard. Allowing for unforeseen delays this should be figured as 23 minutes per cubic yard.

In addition to the time of the teams and drivers, it is necessary to have at least one man to load the scrapers. He can handle about 150 scrapers per hour, which means that a sufficient number of scrapers should be employed to have them load on 24-seconds headway. Where a less number of scrapers is in use the helper's time will be distributed over their work at a proportionately greater cost per cubic yard.

Wheel-scraper work may be figured by the same method; in each case the actual capacity should be taken as eighty per cent of the rated capacity, and the cost of a "snatch" team should be included when the rate capacity of the scraper exceeds 14 cubic feet or where the incline is steep.

When the earth is loosened by the plow to prepare for scrapers, the cost of plowing will, of course, be the same as when preparing for hand shovelling.

Steam Shovel Digging

For very large and fairly deep excavations a steam shovel should show an appreciable saving over any other method of excavation. However, most building contractors do not make a practice of owning their own steam shovels, but will sub-let such work to an excavating contractor at a lump sum or unit price.

Capacities of different shovels of the same nominal rating will vary appreciably and the estimator should be familiar with the performance of the machine which he proposes for any particular work.

If constantly employed in digging, the following production could be obtained from the various sized shovels:—

¾ cu. yd. shovel,	2.25 cu. yds. per minute.
1¼ cu. yd. shovel,	3.75 cu. yds. per minute.
1½ cu. yd. shovel,	4.50 cu. yds. per minute.
1¾ cu. yd. shovel,	5.25 cu. yds. per minute.
2 cu. yd. shovel,	6.00 cu. yds. per minute.

But, since a great portion of the time of the shovel will be used in moving, it is not wise to figure upon an actual production of more than one-half of the amounts just given.

The cost of disposing of the material will be the same as for hand excavation, except that the loading time will be greatly decreased, one minute being about the maximum if the work is arranged properly.

In practically every building operation it will be necessary to back-fill and tamp the spaces between the blanks and the construction. When the earth to be back-filled is available alongside the trench, the cost may be figured on the following basis:—

Sand or loam,	2½ cu. yd. per man per hour.
Ordinary medium soil,	3 cu. yd. per man per hour.
Heavy soil or clay,	1½ cu. yd. per man per hour.

When it is necessary to wheel the earth from a pile away from the trench, the cost of such wheeling must be figured as previously explained.

Allowance for Superintendence

No allowance has been made for foreman, superintendent, timekeeper, etc., in any of our figures thus far. The general building contractor will find it most practicable to estimate the total time required for the entire building and to calculate the cost of salaries for superintendent and timekeeper on that basis. The time of foreman must, however, be included in the cost of excavating and, as one foreman can usually handle any ordinary sized operation, the procedure for calculating the unit cost of excavating for a typical building will be as follows:—

It is assumed that the soil is dry clay, that the banks will stand without bracing, that shoveling will be done by hand and the material disposed of in a dump a mile away over fairly good roads.

Plowing:
Cost of team, plow and driver, $1.00 per hour.
Cost of helper, .35 per hour.
$1.35

$1.35
———=per cu. yd .0675
20 cu. yds.

Shovelling
Cost of labor, $ .35 per hour .35
———=per cu yd. .2869
1.22 cu. yds.

Hauling:
Cost of team, cart and driver, $1.00 per hour.

Loading time	10 minutes
Dumping time	5 minutes
Travelling loaded,	30 minutes
Returning,	20 minutes

65 minutes at $1.00=
1.0833
———=per cu yd .9028
1.20

Trimming dump, $\frac{.35 \text{ per hour.}}{10 \text{ cu. yds.}}$ = per cu. yd.	.0350
Foreman, receiving 75 cents per hour straight time, will average 90 cents per hour actual time, allowing for rainy days, etc. Assuming that the entire gang is proportioned to handle the maximum amount loosened by the plow, the actual production will be 20 cu. yds. per hour, therefore, $\frac{.90}{20}$ = per cu. yd.	.045
The water-boy at 25 cents per hour will cost per cu. yd.	.0125
	$1.3497
Contingencies, allow 5%, per cu. yd.	.0675
Compensation insurance:—	
5% on payroll,	.0198
3% on team-hire,	.0285
	$1.4655

or $1.47 per cubic yard, exclusive of general supervision over-head costs and profit.

Bracing

Bracing used in ordinary building excavation may consist of wood, concrete or steel sheet-piling. Concrete and steel sheet-piling will be discussed in a later paper.

Thickness of plank to be used for sheet-piling and the spacing of waling strips and braces will, of course, have to be determined by calculating the load which the piling must retain. This is calculated after ascertaining the weight per cubic foot of the material and its angle of repose.

However, for excavations not over ten feet deep, 2" plank with 6 x 6 wales not over 5 feet apart, the wales being supported by bracing not over 7 feet apart, will usually suffice.

For excavations 10 to 15 feet deep it is best to figure upon 3" plank with 8 x 8 wales, not over three feet apart near the bottom, and for 15 to 20 feet deep 4" plank should be used.

Wood sheet-piling will seldom be found economical for greater depths than twenty feet.

Where union rules or other restrictions do not prevent it, the entire work of sheet-piling can be done by handy laborers, provided they are directed by an experienced man. Where union rules require it, it will be necessary to allow for having certain parts of the work done by carpenters.

Bracing Production

Production can be figured upon the following basis:—

Setting braces and driving piles:	
For first 10 feet of depth,	10 sq. ft. per man per hour.
From 10 to 15 feet deep,	9 sq. ft. per man per hour.
From 15 to 20 feet deep,	7 sq. ft. per man per hour.
Pulling piles and removing braces:	
For first 10 feet of depth,	40 sq. ft. per man per hour.
From 10 to 15 feet deep,	35 sq. ft. per man per hour.
From 15 to 20 feet deep,	20 sq. ft. per man per hour.

Of course, the men will work in a gang of two or four, but the cost is to be figured upon the basis of the production per man.

The amount of material required for sheet-piling will be determined by the number of times the piling can be used over again on the same job. On most moderate sized jobs it will be advisable to provide enough plank and bracing to enclose the entire excavation at once.

Example:—To find the cost of sheet-piling for an excavation 60 ft. wide, 100 ft. long and 10 ft. deep. The plank will need to be at least two feet longer than the depth of the footing, that is, twelve feet long.

Distance around excavation 320 lin. feet.		
320 lin. ft. x 12 ft. plank x 2" thick=	7680 f.b.m., plank	
Wales—3 lines 6 x 6's 320 feet,	2880	
Braces—6 x 6's, 45 each 8', 10', 12',	4050	
Stakes—8 x 8, 45 6',	1485	
	8415f.b.m., bracing	
The area to be piled is 320×10 equals 3,200 sq. ft.		
3200÷10=320 hours driving, etc.		
3200÷40=80 hours pulling.		
Fractional hours are here considered as full hours.		
7680 f.b.m. plank at $36.00 per M.=		$276.48
8415 f.b.m. bracing at $44.00 per M.=		370.26
		$646.74
Deduct 60% for re-use value of lumber,		387.06
		$259.68
Spikes (estimated at 20 lbs. per 1000 f.b.m. bracing) 168 lbs. at .05		8.40
Labor driving, 320 hours, at .45,		144.00
Labor pulling, 80 hours at .45,		36.00
Contingencies, allow 5% of labor cost,		9.00
Insurance, allow 5% of labor cost,		9.00
Net cost, exclusive of supervision, overhead and profit.		$466.08

All labor rates and material prices used in these articles are arbitrarily assumed. You should be careful to get the actual rates and prices that will be in effect for every job for which you make an estimate.

Whenever possible, the necessary sheet-piling and bracing should actually be designed by a competent engineer, then the amount of material to be purchased and handled can be figured accurately.

Be sure also that the prices for lumber include delivery to the site of the work. Otherwise, due allowance for delivery must be made.

Note also that we have figured on square edged plank, which are the most practicable. If matched plank should be specified, 15% must be added to the quantity of plank, and 10% must be deducted from the amount driven or pulled per hour.

An article covering the subject of difficult foundation work will also discuss the subjects of steam-driven sheet-piling, pumping, etc.

Factors to be Considered

Whenever you estimate on the cost of excavating, be sure to visit the place where the work is to be done, obtain all the following information, and make proper allowance **in your figures:—**

Nature of soil.
Disposal of top-soil.
Disposal of other excavated material.
Location of dump.
Necessity for spreading at dump.
Local rate for labor.
Local price for teams, etc.
Cost of any permit required.
Necessity for protecting sidewalk.
Necessity for protecting pavements.
Cost of watchman, if needed.
Cost of maintaining lights, if needed.
Cost of materials, if any are needed.

Also be sure to include in all estimates a proper amount for general supervision, traveling expenses, home-office expense and profit. These items will be referred to again in succeeding articles, but attention is called to them here so that they will not be lost sight of.

Protection Against Scouring on the Capilano River, B.C.

The Methods Used to Prevent the Washing-out of Bridges Across the Stream—Flexible Groins to Check the Action of the Current

By J. B. HOLDCROFT, A.M.E.I.C.
Contract Record Correspondent

As an example, illustrating the truth of the saying that "eternal vigilance is the price of peace," the Capilano River is but one of many, but there are not lacking unique features to the set of conditions with which the engineer, Mr. R. W. Macintyre, assistant engineer, Dept. of Railways, B. C., has had to cope during the last three years. Protection work has been necessary on this river from the earliest days of the construction of the Pacific Great Eastern Railway across its mouth, but until early in 1918 the railway company was satisfied with replacing the trestle bridge when damaged or washed out. It was, however, decided to build a permanent bridge, replacing the existing structure with two 100 foot through Howe truss spans, at the same time raising the rail level 10 feet above the original elevation, in order to eliminate the trouble caused by flood discharge carrying down trees, logs, and drift-wood, which had hitherto periodically caused the destruction of the bridge, during the high water periods.

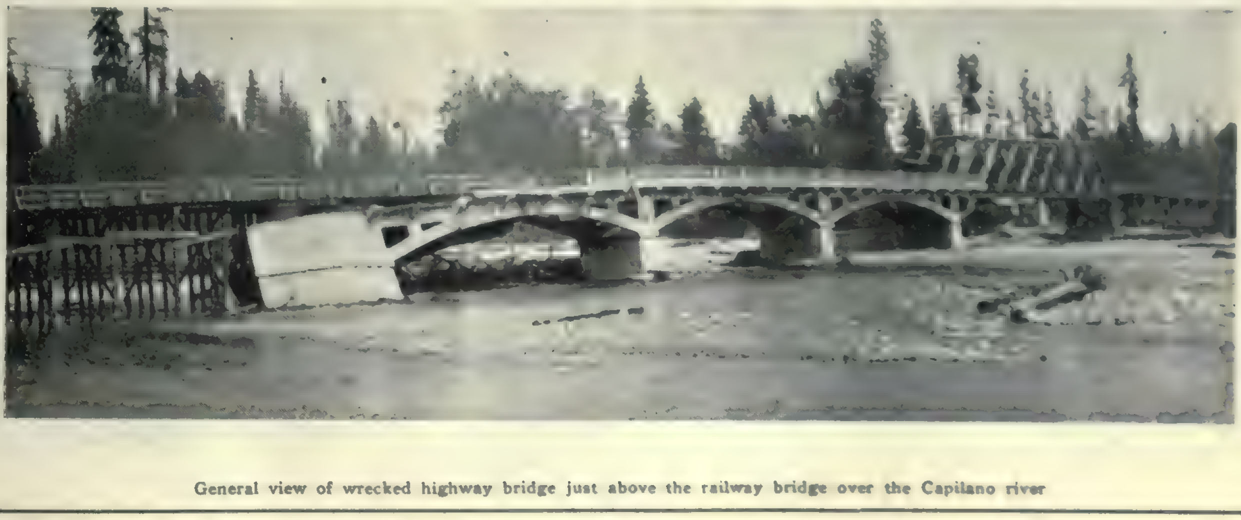
The Capilano River had a drainage area of 64 square miles and rises among the lofty peaks of a mountainous peninsula lying directly north of Vancouver, B. C. Its source is at an altitude of between 1,500 and 1,600 feet, from which it flows in a southerly direction a distance of 20 miles, discharging into Burrard Inlet, at the entrance to Vancouver Harbor. The river is one source of supply for the Vancouver city waterworks, the intake being about 7 miles upstream from the mouth at an elevation of 480 feet, the pipeline being carried submerged across Burrard Inlet to the south shore, on which Vancouver is situated.

The main problem to be solved in connection with the new bridge and grade was how to control the river, which had widened its channel to about 900 feet at the bridge site, although the normal width of water surface, when confined in one channel, would probably not exceed 100 feet. The measured flow of this stream shows a maximum since 1914 of 9620 cu. ft. per sec. and a minimum of 35 cu. ft. per sec., but both figures may be considered as abnormal, the average flood discharge being between 2,000 and 3,000 cu. ft. per sec., with low water from 50 to 100 cu. ft. per sec. It was fully realized, however, that the new bridge and its approaches must be designed to withstand the most extreme conditions.

River Bed Formation Presents Difficulties

The geological formation of the river bed presents serious difficulties to the securing of stable foundations, and consists of gravel and large boulders of glacial origin to an indefinite depth. On this river current exerts a digging force which was given practical demonstration during 1917 when the east span of the Marine Drive bridge, about one-half mile above the railway bridge site, collapsed owing to the undermining action of the river on the abutment foundation. This highway bridge was built of reinforced concrete in 1914, and consisted of four 70 ft. span arches, resting on concrete piers, the abutments being of similar construction to the piers with the addition of concrete slab walls which gave the bridge ends an appearance of solidity.

Subsequent experience has conclusively proved that this type of bridge is unsuitable to the conditions of the site and extensive repairs of a temporary nature have been necessary to keep it open for traffic.



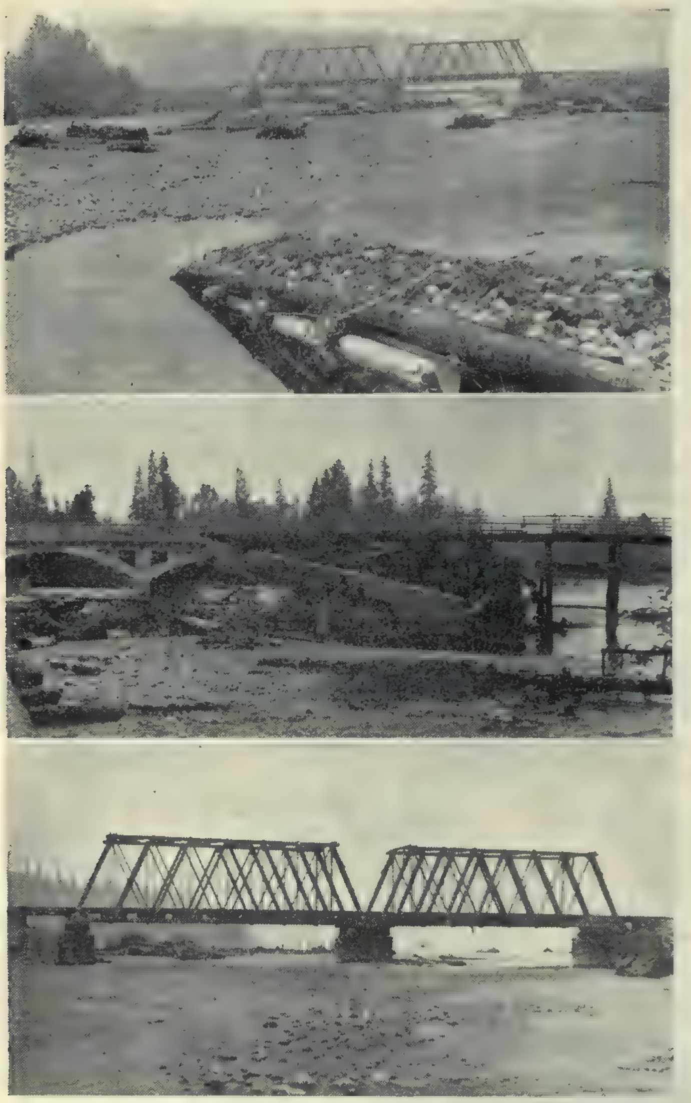
General view of wrecked highway bridge just above the railway bridge over the Capilano river

Its present condition is shown by some of the accompanying photographs.

The contract for the railway bridge was let in April 1918, the plans showing two 100 ft. through Howe truss spans supported on a central pile pier, with abutment at each end, both sub-structure and super-structure being of the usual standard for this class of railway bridge. Pile driving was started during the same month. Delays were encountered, due to freshets, but the bridge was finally opened for traffic on November 7th, 1918.

Construction of Groins

When construction was commenced, the main channel of the river was hugging the west bank, which was rapidly being eroded, endangering the fill at the west end of the bridge. To remedy this condition three log wing dams or groins were built, about 400 ft. apart upstream from the bridge, and approximately at right angles to the current. The dimensions were, length 18 ft., approximate width 6 ft., and height 4 ft., each crib resting on a mat made of brush and wire fencing. The principle of the whole structure is to obtain the maximum of flexibility, so that if erosion occurs the rock filled crib at once sinks into cavity formed and checks the action of the current. Before the cribs were filled with rock, wire fencing was dropped inside to form a loop with the ends projecting above the sides. Loose brush was then spread over the bottom, the whole being then filled with gravel and rock to the level of the top logs. The shore end of each groin was let into the bank about two or three feet and protected with a wire and brush mattress from top to bottom. The height should be so regulated that high water flow will cover the cribs to a depth of about 2 feet, to avoid the destructive impact of floating logs and other detritus.



Upper—The railway bridge showing constricted openings of 200 ft., total width at mouth of river bed 900 ft., in width.
Centre—Wreck of west abutment of Marine Drive bridge, due to scouring action of current.
Lower—Wing dam above railway bridge, showing the bar formed in in bed of river by its agency

The action of these wing dams is to cause a strong eddy which carries gravel and boulders behind the cribwork on the down stream side, forming a bar. The upstream side is usually more or less undermined by the current and these were no exception to the rule, but owing to the flexible construction at once adapted themselves to the changing contour of the bottom, checking further erosion. One in particular was caused to tilt as much as 60 deg. from the vertical, but no lateral movement developed.

Protection of East Bank

Within a few months of construction of these cribs, which were from time to time lengthened somewhat as necessity indicated, a solid bar was built up along the west bank of the river, effectively protecting it from further erosion in that stretch. The current then changed quickly to the opposite bank and threatened the fill at the east end of the bridge, emptying the east abutment crib of its rock filling by scouring beneath the sheeting. Prompt action was necessary to meet this emergency. Continuous loops of wire fencing were dropped inside the empty abutment, followed by a thick layer of green brush on which loose rock was dumped to complete the refilling. In addition to this a brush wire mattress was woven and sunk vertically down the nose of the abutment, the ends being swung into place along each side by the force of the current. Similar methods were necessarily adopted shortly afterwards in connection with the centre pier which was undermined and emptied in exactly the same manner, the river also scouring out a hole 16 ft. deep immediately behind it, which was filled as follows: A wire brush mattress was sunk for a foundation and was followed by heavy loose rock filling 5 ft. in height, wire fencing being laid on top to completely cover the area of fill. A second layer of loose rock was similarly covered with wire and the final 6 ft. section, which completed the fill, was mattressed about 18 inches below the level of the river bed.

In addition to this work on the piers, the east bank was mattressed for a distance of 900 ft. upstream, as the river showed a tendency to excavate a new channel through the flats, which lie at an elevation of from 8 to 10 ft. above low water level. This work as completed has during the past 2 years been subjected to severe flood tests without sign of erosion, although from the nature of the case it is essential always to keep the work under close observation. Owing to attempts at protection works in connection with the highway bridge before mentioned, which have not proved so successful as the works here described, the course of the river has swung over to the west side again, upstream of the railway bridge protection works, and to insure these against damage it may become necessary to use the same methods over again in this higher reach.

Motor Truck Regulations to Reduce Highway Wear and Tear

Maximum Loads and Speeds Need to be Defined if Impact Effects Are to be Minimized—The Danger of Overloading and Overspeeding

By C. W. CORNELL
Manager, The White Co., Seattle, Wash.

Before the Canadian Good Roads Association

To construct highways which will meet the requirements of the future and keep within reasonable bounds in the matter of cost, careful consideration should be given to the loads which these highways will be called upon to support. The structural engineer cannot design a warehouse floor, unless he knows the maximum load per square foot which is to be carried, and so the highway engineer and road builder must be given some definite data, regarding the gross weight of the heaviest vehicle which will be allowed on the highway.

Considerable attention has been given in the United States during the past two or three years to the study of the impact or blow delivered to the road by moving vehicles. The most notable of these studies are those carried on by the Bureau of Public Roads at Washington, D. C., and the quasi public experiments carried out by the Columbia Steel Company at Pittsburg, California. The Washington experiments are still under way, but several progress reports have been made. The Pittsburg work has been completed but the engineer's report is not as yet avialable.

Factors Involved in Impact

Without going into details as to the results of these experiments, it might be stated that the following facts have been reasonably well established.

(a) Impact may be as high as seven times the static load on one rear wheel, when a solid tired truck strikes a one inch obstruction at 16 miles per hour, an average value being about four times.

(b) For pneumatic tires the maximum impact is probably not more than 1¾ times the load on the rear wheel, and average value is not more than 1¾ times the load.

(c) The impact developed by a vehicle, either solid or pneumatic tired, on a smooth road, is less when running, than when standing still; however, if the road becomes rough, impact increases rapidly.

(d) Spring suspension, unsprung load, shock absorbers, cushion tires, load distribution, etc., all have an effect upon the impact.

(e) In general, it may be said that a heavy vehicle, having a heavy unsprung load, and badly worn tires, operating on a smooth road produces a relatively small impact, and consequently does comparatively little damage, while the same vehicle operating on a rough or uneven road creates impact proportional, in some degree, to the roughness.

The conclusion, therefore, is that if we construct our highways with smooth surfaces and maintain them in the same condition, we need only have consideration for static loads, but if the road surface is rough, either because of poor construction or improper maintenance, we must study the effect of impact and provide means of overcoming its effect. Theoretically, a perfectly smooth highway which will bear the standing or static load without failure will continue to do so indefinitely. However, our theory is spoiled in practice, because of wear due to abrasion, the action of the elements, the settling of the subbase and last but not least, the movements of the slab or surfacing, due to temperature changes.

Maximum Allowable Loads

To determine the maximum allowable loads which may be carried on our highways, we should reduce all of our data to the load per square inch. Determinations have been made of the crushing strength of well made concrete road slabs, and values carrying between 2,400 and 3,300 pounds per square inch have been obtained. Assuming 2,500 pounds to represent the crushing strength, and bearing in mind that impacts may run as high as 7 times the static load, we divide 2,500 pounds by 7 and obtain 357 pounds which represents the total allowable static load per square inch.

The following table represents the results of investigations carried on by a well known tire manufacturer, relative to the respective contact areas of

Tire width in inches.	Capacity load in pounds.	Load per inch width in pounds.	Width of tread in contact inches.	Percentage of width in contact to base.	Peripheral contact in inches.	Peripheral contact per 100 lb. load in inches	Area contact in sq. inches	Pounds per square inch
3½	1,300	327	2.28	65.0%	5.79	.445	13.2	99
4	1,700	425	2.50	65.5%	5.71	.336	14.3	119
5	2,500	500	3.25	65.0%	6.89	.276	22.4	112
6	3,300	550	3.94	75.8%	6.96	.205	27.4	120
7	4,200	600	5.31	75.8%	7.16	.170	38.0	111
8	5,200	650	6.25	80.8%	7.61	.146	47.6	107
10	7,000	700	8.06	80.6%	7.85	.112	63.3	111
12	9,500	792	9.50	79.1%	8.40	.089	79.9	119
14	11,500	822	11.50	82.1%	8.61	.075	99.1	116

various sizes of new solid truck tires, when loaded to capacity.

It is to be noted that while these contact areas and loads per square inch, give us a general idea of conditions surrounding this very important subject, they are subject to considerable change, when we consider varying makes of tires, tires with high or low profiles, tires capable of deformation under moderate loads, and tires which have been so worn out as to reduce their flexibility to a minimum. In general, it is reasonable to make the following assumptions regarding tires which have been worn to some degree, but not to the point of losing all their deformation qualities.

(1) The width of contact of the tire with the pavement is 75% of the width of the base between flanges.

(2) The peripheral contact varies from 5.8 inches to 8.6 inches for new tires and will probably have a conservative value of 4 inches for worn tires.

800 Pounds per Inch Width of Tire as Maximum Load

Assuming that the working load on a concrete pavement should not exceed 357 pounds per square inch, we make the following calculation: Working load 357 pounds x 4 inches of peripheral contact=1,428 pounds per inch width of contact. 1,428 pounds per inch width of contact x 0.75=1,070.

It would, therefore, appear that a loading of 1,070 pounds per inch width of tire, measured between the flanges of the base, would represent even under adverse conditions, where the impact becomes as much as 7 times the static load, a load that is not excessive. Recognizing, however, that tires frequently become badly worn, and that overloading is still somewhat prevalent, our National Automobile Chamber of Commerce has recommended a loading of not to exceed 800 pounds per inch width of tires, base measurement.

A study of trucks of various makes and capacities develops the fact that the usual or average distribution of the gross load between the front and rear axles is 20% and 80% respectively. The maximum size of tire in use on rear wheels is 14 inches; therefore, the total allowable load on the rear axle is 2 x 14 x 800=22,400 pounds and the gross load on 4 wheels is $\frac{22{,}400}{80} \times 100 = 28{,}000$ pounds which is the maximum allowable gross load recommended by the N. A. C. C.

It will be noted that the foregoing recommendations with reference to gross weight and weight per inch width of tire apply only to trucks equipped with solid tires. Investigations have demonstrated that the pneumatic tired truck or bus does little if any damage and inasmuch as the gross load which may be carried on pneumatics is closely limited by the carrying capacity of the tires themselves, it is not considered necessary to limit the weight on this type of tire equipment.

Effect of Speed

Speed is evidently a factor in impact, but to what exact extent has not been determined. We can only say that trucks equipped with solid tires operating at speeds greater than 20 miles per hour will in all probability do considerable damage to the highway if not to the trucks themselves, and if they be of the heavy duty type will be a menace to safety.

The following schedule is offered as being sufficiently restrictive to protect the highway and still allow the operator the right to use his vehicle to the best advantage: When the gross weight is not over 15,000 pounds, a speed of not over 20 miles per hour; when the gross weight is over 15,000 pounds, but not over 24,000 pounds, a speed of not over 15 miles per hour; with the gross weight over 24,000 pounds, but not over 28,000 pounds, a speed of not over 10 miles per hour.

Danger of Overloading

Nearly all reputable manufacturers of trucks are attempting to educate truck operators as to the folly of overloading. They demonstrate that the life of the truck is reduced and its daily cost of operation increased. The net result clearly shows a loss to the owner. In addition to these very good reasons for restraining overloading, we are daily becoming more impressed with the fact, that overloading is playing a very important part in highway destruction.

To simply restrict the gross load to 28,000 pounds, with the further proviso that 800 pounds per inch width of tire be not exceeded, is not sufficient. These restrictions do not, in fact, affect any but the heavy duty trucks. A small truck, say a 1½ ton equipped with 5" rear tires, may carry 8,000 pounds on the rear axle or 10,000 pounds total gross weight. The average 1½ ton chassis and body weighs 5,400 pounds which leaves a pay load of 4,600 pounds, or an overload of 1,600 pounds or 53%. As a matter of fact, the smaller size tires should not be loaded in excess of 500 pounds per inch width, because of the fact that the depth of rubber is much less than in the larger sizes.

We therefore see that to obtain complete protection for the highways we must prevent overloading. It is my opinion that this can be accomplished best by requiring each manufacturer of trucks to file with the proper state or provincial authorities, a schedule showing the various models which he manufactures, together with the rated capacity of each and the standard tire equipment. Owners should then be required to register their trucks and pay license fees according to capacities. This system will not only prevent the overloading of trucks with attendant dangers to public safety, but will prevent overloading of tires beyond their rated capacities, and thus protect the highway. This system will also insure the owner paying a license fee in proportion to his capacity of truck.

To facilitate the enforcement of the law it would be well to require that all trucks have painted on each side in block letters not less than twelve inches high the capacity in tons, and also in small letters the actual weight of the truck unladen (tare.)

Conclusions

Finally I should like to draw several conclusions, which I believe will be of assistance in the promotion of good roads, and in making use of these roads to the best advantage possible.

(1) Some exact limit (say 28,000 pounds) should be fixed as the maximum allowable gross load on four wheels. It would be preferable to have this limit uniform throughout the country, as it should remain in force for a number of years.

(2) The maximum allowable load on solid tires should be not more than 800 pounds per inch width, base measurement.

(3) Speeds on solid tires should be not greater than

20 miles per hour and reduced in proportion to the gross weight of the vehicle.

(4) No speed or road regulations are necessary for pneumatic tires.

(5) Trucks should not be loaded in excess of the manufacturer's rated capacity.

(6) Highways should be constructed with smooth surfaces.

(7) Well organized maintenance of highways should be in vogue, and the keynote of this maintenance should be smooth surfaces.

Letter to the Editor Comments on Action of Ground Water on Concrete Sewer Pipe

Editor, Contract Record:

In your issue of March 29, 1922, an article by Charles Abbot Newhall, consulting chemist, Seattle, Wash., entitled "Action of Ground Water on Concrete Sewer Pipe" has been read with considerable interest. We take exception to many of the statements made by Mr. Newhall, particularly those under the captions "Concrete Pipe Easily Destroyed" and "Failures in Vancouver."

Mr. Newhall's experience has undoubtedly been with the irresponsible, incompetent manufacture of concrete pipe and tile of which there have unfortunately been many in the past. Concrete pipe improperly made, when poor materials, too dry a mix and no curing facilities are employed, can be expected to fail. When these failures occur, some engineers as well as state and government officials immediately attribute them to action of acids or alkaline salts when no such conditions exist, the failures being due entirely to the poor quality products.

As a specific example of this, the drainage officials of the University of Wisconsin have claimed for a number of years that it is unsafe to use concrete drain tile in peat soils of Wisconsin where, it is claimed, that a high concentration of soil acids exist, probably the strongest in any section of the country. Up to two years ago the Wisconsin officials advocated the manufacture of concrete drain tile by farmers and encouraged the small incompetent firms in the business. The result was failure of many of the systems which could naturally be expected.

In order to prove that the failures reported in Wisconsin in 1920 were due to poor concrete tile, the writer conducted an investigation in 1921 in which 53 inspections were made of drainage systems on 38 farms in nine counties of that state. Samples of soil, soil water and drain water were taken according to prescribed methods and sent to Chicago for analysis in an internationally recognized laboratory. Practically all of the specimens gave a slight alkaline reaction and few showed a slight acid reaction, none of which would have any effect on litmus paper. A precise analysis revealed that the strongest soil acid in Wisconsin was so weak, relatively speaking, that it could have no effect on well-made concrete pipe or tile.

Professor Emil Troug of the University of Wisconsin, internationally recognized as an authority on soil chemistry, made the following statement under date of October 26, 1921: "The acidity of the soils solutions of the most strongly acid soils is only about two per cent as great as that of the gastric juice of man. The acidity of the gastric juice in man's stomach is 50 times as strong as the acidity of the soil solution of the most strongly acid soils of Wisconsin."

While the class of drain tile produced in Wisconsin prior to 1920 was of a very low quality, only about 6% of that investigated was found in bad condition. Samples of tile were found that had been giving excellent service in peat soils of Wisconsin from 4 to 32 years.

Responsible manufacturers of concrete pipe should not be made to suffer because of the failures of products produced by the irresponsible manufacturer, particularly when there are existing national standard specifications for both concrete and clay sewer pipe and drain tile. These specifications were prepared by committees of the leading engineers of the country including equal representation from the concrete and clay pipe interests. Concrete pipe has been successfully used for sewers, culverts, drainage and irrigation systems in America for over 60 years and for much longer periods in foreign countries. In fact, many enthusiasts claim that the Romans used concrete in many of the water supply systems of ancient days. Where the products were properly made they gave good service and failed when improperly made. This also applied to clay sewer pipe and drain tile.

In Wisconsin and Minnesota as well as many other sections of the United States many examples of clay failures have been found due either to frost action or insufficient strength. These failures were not due to anything but poor quality products, and the manufacturers of recognized high standard clay products should not be held responsible for these failures. Engineers in charge of building sewerage or drainage systems should insist on tests for both classes of pipe as this is the only way in which these failures can be prevented.

Much has been written in the Canadian journals about the failure of concrete pipe in sewers in Vancouver, B. C. Mr. Newhall mentioned this as a specific example of the action of certain chemicals in the soils. A number of articles have also been written by Mr. A. G. Dalzell, formerly assistant city engineer at Vancouver. On May 27, 1922 the writer interviewed Mr. F. L. Fellowes, city engineer of Vancouver as well as the former president of the Dominion Glazed Cement Pipe Company of Vancouver which manufactured the pipe used in Vancouver between 1910 and 1913. Mr. Fellowes stated emphatically that the failure of concrete pipe in Vancouver was due, in his opinion, to the poor methods used in manufacture, as the mix used in the pipe was too dry and insufficient precautions were taken to cure the product before it was installed. The former president of the Dominion Glazed Cement Pipe Company also stated that this was the principal cause of the failures that have occurred in Vancouver. Over 50 miles were used in that city and up to date a very meagre percentage has failed. Mr. Fellowes further stated that in his opinion no acids or alkaline salts existed in the soil of Vancouver, particularly at the points where some of the concrete pipe sewers have failed, as the soil consists of glacial drift, in which conditions of this kind rarely occur.

Among the engineers that have in the past rejected the pipe manufactured in Vancouver, typical of that used in Vancouver sewerage system, are the following: F. M. Preston, city engineer, Victoria, B. C.; J. W. Blackman, city engineer, North Vancouver, B. C.; H. Stewardson, city engineer, New Westminster, B. C.; W. B. Gregg, municipal engineer, Point Grey Municipalities, Kerrisdale, B. C.

Yours truly,
M. W. LOVING,
Secretary, American Concrete Pipe Association.

A Sense of Service to the Public

What the Construction Industry Requires—The Possibilities of the Industry Outlined in an Address Delivered at the Organization Meeting of the American Construction Council

By WILLIS H. BOOTH
Vice-president Guaranty Trust Co., New York

There are many kinds of business which, broadly speaking, enter into the construction industry, and these in turn are affected by so many divergent interests, that it is a really great task to endeavor to gather them co-operatively together. But this very fact that the component parts of construction are scattered in interest and direction emphasizes the importance of an effort to assemble them so that they may function to good purpose.

This meeting is only the natural culmination of a movement which has been agitating the business world in recent years when we have been struggling and striving, and not always sure where we are going either, to work our problems out. We have seen that co-operation in labor is necessary but that it may be badly guided and become a public peril; that co-operation in capital, while it might be wise under proper direction, becomes distinctly contrary to the public good under evil direction. The same applies to agriculture. The task of co-operation which shall bring into play those forces which make for good and shall eliminate, by the combined weight of public opinion and of law, those forces which make for evil now rests heavily upon all of us. Nobody wants a country stratified in its interests, with hard lines of demarcation between labor, industry and agriculture, for the very obvious reason that one cannot exist without the other.

You who represent the various phases of the widely diverse construction industry have, therefore, had this brought home to you more definitely than have some other lines of business. It is this realization which brings us here today in an effort to set in motion a new machine having for its great purpose the co-ordination of capital, labor and management in the construction field for the benefit of the industry and for the public good.

Hard to Get Co-operation

Differing from most easily determined industries and, at the same time, touching or comprehending practically all industry, construction has been a hard line of business to get into intense co-operation. It is so widely scattered in its character that it has been obliged by force of circumstance to gather itself into a great many groups, each representing a phase of the business. This was one of the steps in the evolution that has brought us by perfectly normal stages to this meeting. It would be perfectly impossible to endeavor to accomplish what measures up to the ambition of this meeting if we had not previously organized national trade associations of one character and another, which in the main comprehend the entire industry. These trade associations when legitimately operated surely serve a most useful purpose. We must not blind ourselves to obvious conditions. The construction industry has here and there some housecleaning to do. It is very much better that it be done within its own ranks. It is equally within reasonable expectation that if this council is broadly supported it can crystalize business practices and policies within the trades that will prevent unfortunate criticism in the future.

I appreciate full well that it is not going to be an easy thing for any council of men, no matter how intelligent they may be or how fair their methods of selection, to gather together at any time and be able to guide all of the factors in such a great industry as this. There are so many branches of the business. In most cases manufacturers do not produce a finished product but only a semi-finished product, so far as its ultimate use is concerned. Construction materials, broadly speaking, are but raw materials, and construction equipment but tools. And then the contractor comes in and, whether it be a building or a bridge, a highway or an ocean liner, by assembling the materials and equipment and labor and executive direction, he produces the ultimate structure. It is only necessary to recite these component parts of raw material, labor, equipment and executive direction to emphasize again their mutual dependency The executive direction implies the business management of the contractor associated with the highly technical skill of the architect and engineers in the various lines of engineering. As the matter now stands these component elements are thinking of construction largely in the light of its particular interest, to them. This is natural. But in forming this council we appeal to more enlightened selfishness and feel confident of support on the basis of a more intelligent service to the public. It is this intelligent co-operative service which we hope to demonstrate will be of great practical value to every individual whose contract reaches to the construction field. This council is designed to be primarily a practical thing. The construction is not devoid of vision. No one who builds anything can do so without vision. We know that if this movement can be worked out to its ultimate that the entire standards of construction operation will be bettered and relationship with the public be even greater increased in confidence and respect.

The Work of the Council

But just as we had to reach to the council over the road of trade associations, in the same way this council must reach its ultimate ambition over the road of quietly and gradually developing co-operation between labor, material, equipment and management. In setting up the organization we are only doing a roughing-in job. We are perfectly familiar with the fact that as matters stand now the manufacture of any of the various materials entering into a job has little or no direct responsibility to the owner. The professional advisers have the aloofness from both the manufacturing and contracting branches which naturally comes from the contrast between professional and commercial standards. The contractor is not a free agent of the owner, but works under the direction of the architect and the engineer. In some cases he is forced to undertake a contract which, while appealing to professional direction, is not mutually advantageous as between the contractor and the owner.

Up to this time there had been no clearing house for these differences of viewpoint. No place where the representatives of each line of effort could sit down and talk the matter over, fully confident that he would be not only accorded a fair hearing, but that he would be properly represented in any decisions that might be reached. Of course, no judgments can be reached except on matters of policy. It is these great matters of policy that make the framework of all our industrial relations.

When we think about policies and want to make up our judgments we must ascertain the facts. And so we find that before we can make a judgment covering a policy in the construction business, or in any other business, we must have before us the statistical information which, coupled with our practical experience, gives us the groundwork upon which conclusions may be based. This council then naturally becomes a clearing house for the information contained in the industry as a whole. Theoretically this is simple. Practically it is not going to be so easy. But I have every confidence that step by step it will prove its value, will develop the support and co-operation of the component parts of the industry, and ultimately will be so equipped as to have first-hand information on all the elements of vital importance in every phase of the construction business. If this council endeavored to do no more than would be contemplated by this effort, it would, it appears to me, offer every reason for its existence.

Developing Confidence

There is nothing more dangerous than half truths. When this council endeavors to compile the statistics of an industry it must be very sure it has gathered every possible bit of information available, and then must give the same out frankly and completely, whether it affects the industry advantageously or not. This is the only way that confidence will be developed, and this council will rise or fall in its effort entirely upon the confidence which is engendered and the value which the public, no less than the component parts of the industry, places upon its observations and recommendations. This statistical information, if properly compiled and gathered as it must be from the trade associations and the departments of the government directly associated with these matters, can be of inestimable value to those manufacturers, especially the smaller ones, whose business it is to provide the supplies for the construction industry. I am fully aware that this situation has been well cared for, particularly in specific lines, but I am advancing the hope that the council will be able to develop itself into a clearing house of statistical information for the whole industry that will be of inestimable value to everyone connected with it.

This council, too, representing so completely all of the various phases of industry, should be powerfully instrumental in having the construction business appreciate its own magnitude and importance and its effect upon the prosperity and well being of the nation. This would have the natural result of inspiring at least a portion of those engaged in the business to a kind of a dual business patriotism, a patriotism on the one hand which would make them take pride in and be loyal to the business which makes their daily occupation and, on the other hand, be conscious of and loyal to a sense of general public service and public responsibility. I am not speaking as an altruist, nor dreaming dreams of intangible things. We must learn in this business, if we have not already done so, that all large corporate interests have learned in their specific fields. The old days of figuring that we can operate our businesses without regard to the public have passed away, and the large corporations that are doing the best are those which are working in sympathetic co-operation in the enforcement of laws which recognize the public rights and in operating their businesses in full accord, four-square, with rational public sentiment. Of course, this would naturally develop a business consciousness, a sense of obligation, in the wake of which would come more reasonable co-operation throughout the entire business.

Obligation to the Public

And at this point the public would come in. The abuses which have beset this industry, as they have beset all other industries, would be gradually cleaned out from within and a permanent set of business morals established which would prevent a repetition of practices which seemed to give temporary advantage, but which, in the long run, are, from a strictly business point of vew, unprofitable. In the last analysis the public pays the price. Of that public we are all a part. We like to criticize the other fellow's business but we don't like him to criticize ours. But we can't prevent such criticism, no matter how we try, if it is warranted by the facts. The clear common sense of the situation, then, is to put our own house in order to clear ourselves of criticism, and then to criticize the other fellow's business as freely as we wish until he in turn has done exactly the same thing.

There is no end to the practical things which may be done if we have the patience to work them out slowly. Our greatest trouble in all co-operative efforts is that we try to be independent of human equation and to endeavor to reform the world overnight, but we have reasonable expectation by the proper adjustment of the work of each craft to give us a lengthened construction season. It may not be too much of a vaporous dream to hope that ultimately we may develop such a sufficient mutual confidence as will prompt labor to co-operate in the lengthening of the number of productive days per year per man in the construction industry of this country.

It may also be possible at the same time and by the same character of co-operation to expand the apprentice system so that we may have the ranks of skilled labor continually augmented by the oncoming generations.

I keep continually coming back in my thought to a sense of this feeling of public responsibility, because I can see this council in the great functioning which is before it exposed to the danger of thinking too exclusively in construction terms. The resulting stratification is something which we must all deplore. So when we urge this council as a means by which the industry may become articultate and represent its viewpoint to the public, we do so with the full appreciation, first, of the necessity of this articulate capacity and, second, with the appreciation that it must always consider the public interests in its expression. This does not involve entire unselfishness; it only contemplates enlightened selfishness. With this in mind, it would be a service of inestimable value if the construction industry were able to present to the transportation industry of the country a proper picture of its needs and all the service which it had a right to expect. It also would be of the greatest value if it could give public expression to its views on the financial operations of this country, because our banking structure, as a clearing house of all business, needs whatever information it can get from reliable sources. In this country we are now engaged in the task of taking a nation whose economic life was largely based upon agriculture and adding on to this agricultural base a superstructure of industry and getting the two to mold together. Between these two great forces, the agricultural and the industrial forces of the country, the banker is obliged to operate. He must provide capital for the initial production of wealth and he must direct the wealth into profitable employment after it has been produced. His position becomes one of great responsibility, and his responsibility to the public is always being impressed upon him.

The Bankers View of the Construction Industry

Of course, there are many sides to the banking business as there are to the construction business and this is not the time or place to go into an intense analysis of the different methods of operation. But it is in line with the topic under discussion to emphasize the fact that he must at all times conduct his business so as to command public confidence. Looking at the construction industry through the banking glasses and with the public interest generally in mind, it becomes obvious that the public cannot be adequately served when an industry lacks a class consciousness and the feeling of the responsibilities which go with its position. When the aims are not concentrated but are diffused through the various branches, such branches oftentimes being antagonistic to one another, such group interests and group antagonisms subordinate the rights of the industry as a whole and the public whom it serves. When specific groups within the industry insist upon doing things which shock the public consciousness, all of the industry must suffer by such action. Let me emphasize again, then, that the great co-operative movement which this council hopes to accomplish should result in the elimination of practices which, while beneficial to one group within the construction industry, are disastrous indeed to the industry as a whole.

This council then will also have a dual character of operation. First, it must use its influence within its own industry and, second, it must interpret that influence and that industry to the public. It must give the public an adequate picture of what the construction industry is, how it functions, the extent and character of its obligations, its ultimate needs in the way of legislation, and its determination to eliminate bad practices from its business. It does not take many words to outline this little program, but to endeavor to fulfill it is a task which requires the greatest ability the great devotion and, I might also add, no small amount of contribution. We know what the result will be if the building industry will do exactly what public utilities throughout the country have done in a very large way, that is, win the confidence of the public by taking the public into its confidence, create a more stable industry—and stability in industry is just as important to the public as it is to the members of the industry themselves. An excessive inflated condition on the one hand or a depressed condition on the other are equally unfortunate. Actual stabilization is, of course, impossible, but efforts which tend towards stabilization are not impossible, and every bit that is accomplished adds immeasurably to the public good. In the establishment of confidence and in the improvement of stability all phases of the industry will feel more sure of their position, and this great industry will more nearly come in to its own.

It is a great work full of alluring prospects and depending for its success upon the integrity of purpose and the unselfish devotion which guides it. Business is going to have its ups and downs. Conditions are very unsettled throughout the world, our situation at home, as we all know, is very largely dependent upon what happens elsewhere, but through all of this if we keep our feet on the ground and our hearts in our work, this council can go on to do constructive and practical things day after day under most magnificent leadership.

Building Roads to Last

Surfaces That Wear Out Quickly Are Prohibitive in Cost—The Upkeep of Permanent Pavements

By HON. J. P. HARTMAN, Seattle, Wash.

Before the Canadian Good Roads Association

Mistakes and errors have been committed in many places in road building, but often it is through mistakes that we learn how to do things well. In one state, for instance, millions of dollars were raised by bonds and the amount put into hard-surfaced roads or at least so-called hard surfacing. The material placed thereon did not stand the wear and tear of modern vehicular travel, and in many places it quickly went to pieces. The upkeep became enormous. In some instances it was as high as $1,100 per mile per year and rarely less than $300 per mile. This cost is prohibitive for the road would be gone entirely long before the bonds matured. In one instance a stretch of road was built costing about $102,000 and within two years it had so deteriorated that bids were called for to make the road good. The lowest bid was $118,000 or $16,000 more than the original cost of the road. This would be a comedy if it were not so tragic.

One county in Washington made a heavy bond issue and constructed portland cement concrete surfaced roads to the extent of about one hundred and thirty miles. They have been in use nearly ten years. The upkeep on these roads average less than $5.00 per mile per annum (a negligible sum) and possibly this would have been lower but for the excessively heavy haulage, consisting of saw logs, breaking some of the corner slabs, the loads being up to 60,000 pounds upon the gasoline driven trucks."

The Economic Disposal of Refuge

The Operation of a Modern Screening Plant—Experiments with a Suction Gas Plant—Need for Systematic Tests

An interesting paper was presented at the annual conference of the Institute of Cleansing Superintendents, (British) by Mr. E. Hobson, of Leicester, Eng.

It has been said, he remarked, that salvage was dead and not worth troubling about, but while they might not be able to sell waste paper as they did three or four years ago, and the price of scrap iron and old tins might have dropped to next to nothing per ton, he suggested there were other directions in which to turn, and by so doing it was possible at least to get equal if not better and more economic returns out of the refuse than they did under the fictitious values produced by the war.

In this case of a modern screening plant the refuse was split up into its various constituents—viz, large cinders, small cinders, dust, rags, bones, tins, vegetable waste, and incombustible matter, such as broken glass, pots, clinker, &c. The large cinders could be used direct for boiler firing as at Sheffield, where they had been used for several years for generating steam at the public baths. Where a secondary screen was to make them into fuel briquettes, in which form the dust, they could, of course, be used along with the larger size for boiler firing, but the better way was to make thew into fuel briquettes, in which form a very good fuel was obtained. The dust had been proved to be a valuable fertilizer, especially for heavy soils, and he had no doubt that when it was sufficiently well known it would become widely used for that purpose.

The rags could be cleaned and washed and sold as engine wipers, or sold to paper makers; bones could always be sold or treated in their own works, at very little cost, and made into bone meal or fertilizer; broken pots could be made into grit for poultry, which found a ready sale; glass could be sold occasionally but was scarcely worth storing, and the best way was to tip it with the other worthless material. This had for some time been a drug on the market, but there were signs that the demand was growing, and he believed, with up-to-date appliances for baling, it would be possible in the near future to show a good return on the sale of this article.

Suction Gas Plant Experiments

With regard to paper and vegetable refuse, or garbage, which would have to be in the destructor or disposed of in some other unprofitable manner, Mr. Hobson described some experiments he had made with a suction gas plant designed by Mr. John Wells, formerly Inspector-General of Mines for Egypt. The plant consisted of (a) a generator into which the material was fed, rectangular in plan, and built up of standard cast iron plates; (b) a cascade scrubber in which the ascending gas met a stream of water flowing over a series of baffle plates, this action partially freeing the gas from some of its impurities; (c) a rotary tar extractor which completed the extraction of the tar; (d) a dry scrubber which completed the purification process and from which the gas passed on to the gas engine.

When used for boiler firing the scrubbers and tar extractor were cut out, and the gas was fed direct from the generator to the boiler through a Well's patent gas burner. The plant took up very little space—the one at Leicester stood on a piece of ground about 12 ft. square. It was very simple, with no complicated parts to get out of order, and from what he had seen only required feeding to go on producing gas indefinitely.

The first material used was ordinary dry refuse, in lots averaging 46 cwt., collected from the bin districts in the city. The refuse was dumped down near the plant and forked over to get out the dust, tin cans, and all incombustible material. The selected portion consisted of paper, rags, vegetable matter, large cinders, pieces of wood, &c. This was then fed into the hopper, an ordinary ash-bin full at a time. It was found that the material from the Leicester refuse averaged about 47 per cent. Thus from 46 cwt. of refuse 21.6 cwt. of usable material was obtained which took fifteen hours to put through the producer.

The gas obtained was used to drive a 50-h.p. gas engine operating an air compressor working at 100 lbs. per square inch, which at full load absorbed 20-h.p. The residuals as taken from the producer were 10 per cent by bulk and 20 per cent by weight.

Another test was made by taking 16 cwt. of material such as would have been given off the tail-end of a screen. It consisted of paper, rags, cardboard boxes, vegetable matter, etc. This was fed into the hopper as in the other cases, but it was necessary to feed slightly quicker—owing, Mr. Hobson imagined, to the lighter nature of the fuel—and took ten hours to put through. The gas engine and air compressor were kept running continuously, and although there was not the reserve of power that was obtained from the heavier material there was sufficient to keep up the air pressure to 100 lbs., and therefore it was quite safe to say that 200-h.p. hours were developed. He had also tested ordinary market refuse taken direct from the markets, and a similar result was obtained. There was very little residue in either case.

Needs for Systematic Tests

There might be considerable doubt at present as to whether it would be wise to put down a gas plant to deal with the whole of a town's refuse; yet he was certain that if the matter was thoroughly gone into, and systematic tests made with proper appliances, results would be obtained that would be very interesting if not surprising, and whether it was found suitable or not for dealing with the refuse in bulk. Mr. Hobson was confident that it would prove a valuable adjunct as an auxiliary to a screening plant to take the tailings from the screen, which at present were, in many cases, wasted; or even to a destructor were a considerable amount of light refuse and market refuse had to be dealt with, and with proper use made of the power produced it would help to get rid in a profitable manner of a class of refuse which was often difficult to deal with, and would be another source of power. If used in connection with a screening plant, the power obtained from the tailings consisting of paper, cardboard, vegetable matter, &c., should be sufficient to run and light the plant. The cinders could then be used for other purposes, such as boiler firing, where it was not necessary to use a high grade fuel, or they would be made into briquettes, and so produce a fuel at least as good as some of the coal being obtained at the present time.

Another feature in connection with gas production that should receive attention, was that if material was available (and it should not be difficult to arrange that there was always a day's supply in hand) and the feeding was properly attended to, the supply of gas was fairly constant.

Explosives in Quarrying Operations

Practical Data Covering Drilling and Blasting—Methods of Loading Holes and Firing Charges—Precautions to be Taken

By S. R. RUSSELL

Before National Crushed Stone Association

It is not the price per pound of the explosives that is so important, but the cost per ton on yard of stone produced; not even the explosive cost per yard of the material as blasted but the final cost on the cars, which includes drilling, blasting, loading, transportation, crushing, overhead and all other operating expenses. Blasting affects every item in the cost analysis and if it is not properly done, the cost of each subsequent operation will be higher than it should be.

Drilling to proper depth is of the greatest importance in a quarry. Holes are not generally drilled deep enough below grade. In order to be sure of the proper depth it is advisable to run a line of levels over the floor and on top of the quarry face, establishing permanent bench marks and setting reference stakes at various stations around the face for the drill man. These stakes should indicate the depth to which the holes should be drilled. This little item alone may be worth a great many dollars to the quarryman in a season.

Large Cartridges Advisable

The use of large diameter cartridges is advisable in loading deep well holes and manufacturers can furnish dynamite in all sizes up to 5 inches in diameter. Large cartridges lighten the labor of loading and permit a higher concentration or greater bore hole density of the explosive in the bore hole. When large cartridges are used, very little tamping of the explosive, and often none at all, is necessary. Tamping here does not mean stemming. If holes are dry the cartridges should be slit lengthwise two or three times and dropped or lowered into the hole. The fall causes the powder to spill out, practically filling the hole. Slitting the cartridges is not advisable when water is present. Make haste slowly in loading the explosives in quarries, especially in large holes.

Do not hurry the work but furnish enough help on the job so that loading will go on with dispatch. Such dispatch may often result in saving money, especially if the holes are wet, and besides it means disposing of a rather unpleasant and anxious job quckly. From four to six tons of stone is, as a general rule, considered good for primary shooting in well drill work. If the bottom is heavy or if there is a hard toe, it is best to use a higher strength explosive at that point, loading the upper part of the hole with lower grade.

Do not load holes when too near a steam shovel or locomotive, unless a screen or awning is used to prevent sparks or hot cinders from falling into the hole. There have been some very disastrous accidents from this cause alone in the last year or two.

In well drill work the holes are usually drilled and blasted in single rows. The question often arises whether it is better to blast two or three rows at a time, the holes arranged in staggered order, or one row. Some experienced men think that better results and greated fragmentation are obtained by blasting two rows at a time. Most quarries, however, use the single row system. I am inclined to believe that the single row is best when the face of stone is 50 feet high or over. Below that height, it depends upon local conditions. The general practice within relatively shallow holes, from 20 feet to 30 feet in depth, is to blast from two to five rows at a time in order to break the stone up well and in greater volume so that the track and shovel movements are kept at a minimum.

When more than one row is carried, the holes in the back row should be loaded at least 10 per cent. heavier than those in the front for best results. I believe, also, that the spacing between rows should be less than the distance from the first row to the edge of the face. In high faces, I do not think the double row advisable at all. Often, even in quarries where the face is 50 feet or under, only one row is blasted at a time, but a buffer or blanket of stone is carried; that is, a whole or part of a shovel cut from the previous blast left against the face to be shot.

Object of a Buffer

The idea of the buffer is that it offers greater resistance or confinement to the charge and better fragmentation is gained. It is used in many cases, especially in lower faces, to hold back the material so that the stone is piled up high enough for economical working of a steam shovel and to avoid irregular track and frequent moving of track. I believe in a buffer in the lower faces, especially if a shovel is used for loading. Sometimes, however, too much buffer is used and the stone is not thrown out far enough to permit access for the secondary drilling and blasting. The shovel is consequently often held up until the obstruction is drilled and blasted.

It is often better, especially if the stone lies in heavy ledges and there are open seams, and the tendency is for the ledges to move or slide before the full breaking effect of the explosive is gained, to allow the material to be thrown farther out so that secondary treatment can be carried on before the shovel reaches that point. In higher faces, from 50 to 200 feet, no buffer whatever is used nor is necessary. Each blast is cleaned up before another is thrown down.

There are many quarries where the tripod method of drilling is the most economical. This is apt to be true especially in quarries of low face where the full depth can be carried in one bench. It is a method well suited to quarries where the stratification is irregular or pitching heavily, and where it is impossible to maintain regular benches.

Snake Hole Method

In many of the harder limestone, trap and granite quarries, very economical results are obtained by what is known as the snake hole method. Often a face of rock 50 to 60 feet high can be brought down with a single row of bottom holes which are heavily sprung. This method is commonly used in many of our eastern quarries. The holes are drilled horizontally at the bottom of the face of the rock from 20 to 30 feet in depth and sprung heavily. It is best to start the hole about 3 feet above the floor allowing it to dip so that at the point it is just above or at the level of the floor. It is unwise to start the hole too low. A certain dip must be maintained in order to allow water flow to the drilling surface. Therefore, if the hole is started too low, its point may be several feet below the floor level before springing, and this depth is increased considerably after springing.

Spring holes are usually spaced about 8 feet apart. A strong quick explosive is best suited for springing holes. The first charge should consist of not more than three cartridges of 1¼ x 8-inch dynamite. If there is drill muck or water in the hole this charge will not do much more than clean out the hole and will have a very slight heating effect on the walls of the hole. If the hole is dry, this charge will enlarge it somewhat at the back and heat the walls. In the first case when hole is wet, it is unnecessary to wait longer than one half hour before loading the second charge. If the hole is dry, it is advisable to wait one hour.

The second charge should consist of, say, six cartridges and after firing, 1½ hours should be allowed to elapse before loading the third springing charge. Each subsequent springing charge is increased so that the chamber or pocket made by the preceding one is filled, or perhaps it is best to let the explosive rise a few inches more each time until the necessary size chamber is obtained. Compressed air may be blown into the hole after springing. The air, besides blowing out a great deal of pulverized rock, hastens the cooling of the hole, making work easier and quicker.

Interval Between Charge

Many accidents have been caused by loading the final charge of explosive in the bore holes too soon after springing, the charge taking fire from the heat of the hole. It is, therefore, good policy to wait long enough and to be sure that the hole is cool. A rough idea of the temperature can be gained by allowing the tamping stick to stand in the hole about five minutes and then feeling the end of the stick with the hand to find out whether it has become warm. To be absolutely sure, the interval between charges should be one, two, three, four, five, hours after the first, second, third, fourth and fifth charges. It is seldom necessary to spring more than five times. I would advise waiting after the last springing is done until the following day before loading the holes.

A strong, quick explosive like 50 or 60 per cent. Straight N. G. is best for springing in hard rock. For loading the chamber an explosive of lower strength and slower action is best.

For a secondary drilling, rotating hammer drills are most satisfactory and are now generally used It is good practice to drill the large stone rather than to resort to adobe blasting, or mud capping. It requires about 20 per cent as much dynamite loaded in a block hole to break a stone as it would require to "doby" it. Moreover, an explosive of lower strength than is used for primary shooting can be used for block hole work. Whereas, a strong, quick explosive is required for mud capping, a 20 per cent. or 30 per cent ammonia dynamite is advised for block holes in the dolomites or hard limestones, and nothing higher than 40 per cent. for traps or granites.

Mud capping should not be allowed except in emergency, for it is very wasteful. When mud capping is practical the cost of secondary blasting averages about four tons per pound of explosive, while in block hole work the cost runs from 15 to 18 tons per pound of explosive.

Blasting Methods

Only the best blasting accessories should be used in connection with explosives. Great care should be exercised in testing electric blasting caps and in making connections, the joints being made tight, clean and dry. Only series connections can be made when blasting machines are used as a source of current, because these machines are designed only for series firing, having a low amperage—about 1½—and a voltage sufficient to fire their rated capacity.

It is best to fire big blasts with a power or lighting circuit. Either direct or alternating current of 25 cycles or over will do. It requires 1½ amperes to fire any number of electric blasting caps in series but this strength of current must be maintained all along the circuit. Therefore, the greater the number of caps in series, the higher the voltage or pressure necessary to hold the current up. 1½ amperes and a voltage equivalent to 1½ times the number of caps in the series should be supplied.

It is better, however, when power is used for firing to connect electric detonators in parallel or parallel series. When straight parallel is used, which I like best, in well drill work with electric blasting caps, 1½ ampere should be provided for each cap in the circuit. In this case a high amperage but a low voltage is required. In parallel series, at least 1½, and better 2, amperes should be provided for each series.

In priming deep well drill holes, it is advisable to use sufficient detonators distributed along the charge both to assure thorough detonation and to afford a way out in case one should be broken during loading. At least two caps should be loaded in any fore hole, for assurance.

Cordeau-Bickford or detonating fuse is coming into general use for firing large blasts. Cordeau is especially well adapted for well drill hole blasts and is a very safe, sure and efficient detonator. It is besides very easy to manipulate. Cordeau consists of a lead tube about .22 of an inch in diameter, filled with T. N. T. It has a rate of detonation of about 18,000 feet per second and is therefore of great value as a detonator in quickening slow explosives and assuring complete detonation of explosives of low sensitiveness.

Use of Machinery in Road Building

Mechanical Equipment is Finding Wider Application—Cost of Handling Materials is Reduced — Tendency of Contractors to Over-Equip

By H. L. BOWLBY
President, American Road Builders' Association

Before the Canadian Good Roads Association

When it is understood that the cost of handling on the job the materials that enter into the hard surfaced road runs from ten to fifteen per cent. of the total cost of the pavement, the great importance of doing this work economically is obvious.

Road building to-day is in a machine-made era. The successful contractor is the one who provides himself with equipment suited for economically handling his materials, taking into consideration, of course, local conditions and the available supplies of such materials.

The equipment required depends, first, upon the character of the improvement, whether it is an earth road, gravel road, water-bound macadam, bituminous macadam, asphaltic concrete, bitulithic plain or reinforced portland cement concrete or brick road. Given the character of road to be built, the selection of a proper plant depends upon the size of the job and local conditions.

The common materials to be moved and handled are: earth, sand, gravel, crushed stone, cement, water, hydrated lime, steel reinforcement, asphalt, brick and stone screenings.

The principal new departure in the moving of earth excavation has been the recent development of the use of caterpillar tractors with very large road scrapers and the use of mechanical sub-grade planes for trimming up the sub-grade to the established grade line immediately ahead of the laying of the pavement.

Sand, gravel, broken stone and stone screenings are handled to-day by the large contractors with machinery. Mechanical loaders are used for filling motor trucks or railroad cars. Locomotive cranes, mounted on caterpillar treads, are much used for handling these materials by means of clamshell buckets. In some instances locomotive cranes, mounted on standard or narrow gauge railroad trucks, are used, especially in the large central material yards. When the sand, gravel, broken stone and cement are transported from a central material yard to the mixing gang on the road, small cranes are used to transfer the large batch boxes from the motor trucks or industrial railway to the concrete mixers.

Narrow Gauge Railroad Equipment

Practice in those states that are doing the greatest amount of concrete road building seems to be standardizing on the use of narrow gauge railway equipment for hauling the mineral aggregates to the mixers on the road. The train consists of gasoline or steam locomotives pulling flat cars which carry a number of batch boxes, each containing a full batch for the mixer. Turnouts and switches are provided as needed and moved at night so as not to interfere with the next day's work. Some contractors are hauling the batch boxes of aggregates with motor trucks from the material yard to the mixer. It is constantly becoming more popular, however, to permit the mineral aggregates to be piled on the sub-grade and have the mixing gang work through them.

Water is supplied to the mixer and for curing the concrete pavement by means of a pipe line laid alongside of the road. This practice is almost universal.

In some places the wet mixed concrete is being hauled from a central mixing plant to the road in much the same manner that the "hot stuff" is hauled out from a central asphalt mixing plant to an asphalt pavement under construction. The hauling of this wet mixture is done mostly with dump trucks of various kinds.

The mineral aggregates in a central material yard are handled nearly altogether by machinery. A locomotive crane with clamshell bucket usually unloads the sand, gravel or stone from the cars or scows to large storage piles. From these piles the materials are transferred to appropriately arranged bunkers by means of cranes and clamshell buckets. The batch boxes, whether to be moved to the job by motor trucks or by industrial railway, are filled with the proper proportions of fine and coarse aggregates from the bunkers. Many ingenious measuring devices are used at the bunker gates for proportioning the sand, gravel or stone as the batch boxes are filled.

Handling Asphalt

In the construction of bituminous roads, the mineral aggregates are handled in much the same manner as above described for concrete roads. The chief difference is that the bituminous-concrete or "hot stuff" is always mixed at a central mixing plant and then hauled to the road, dumped, immediately spread and rolled.

The asphalt is usually transported to the central mixing plant in barrels or metal drums, although in some instances it is brought to the plant in tank cars or tank motor trucks. The handling of the bituminous material from the barrels or tanks to the mixer is universally accomplished by means of large melting kettles and small pumps which lift the hot asphalt to the measuring bucket immediately over the mixer.

When motor trucks are used to transport the mineral aggregates to the pavement laying gang, it is usually necessary to provide mechanical means for turning the trucks around on a comparatively narrow roadway. There are on the market a number of turntables which accomplish this purpose satisfactorily

There is a great tendency to-day among contractors to over-equip, to purchase too much plant for the job. The wise contractor has available just enough machinery and equipment. When he is over supplied with equipment he loses money in several ways. Among these are excessive overhead and depreciation, and a general slowing up of the work due to too many "tools" on the job. The wise contractor also hires the best superintendent of construction available, knowing that a hundred dollars extra per month on this expense means many thousands of dollars saved in handling costs.

The greater part of the hauling of road materials since the end of the war has been done in the United States with motor trucks. This practice has been adopted in all of the states. One of the principal reasons for suddenly changing from horses and wagons to motor-propelled vehicles has been the free distribution by the government to the state highway departments of surplus motor trucks. During the past three years there have been thus distributed approximately 30,000 motor trucks of various capacities. The further distribution of several thousand caterpillar tractors of 5 and 10-ton capacity, has given an impetus to the more economical handling of earth excavation. But few communities that have made a trial of moving materials by motor trucks and tractors will go back to the old method of using horses and wagons.

The Welfare of the Engineer

Mr. D. O. Lewis Discusses Conditions Which Militate against the Profession—Reciprocal Relations

Mr. D. O. Lewis took for his subject "Welfare" in addressing one of the closing sessions of the Engineering Institute's Western Professional meeting at Vancouver on June 17th.

In developing his subject Mr. Lewis took very general ground and a wide view of the conditions which at present militate against engineers as a class. Dealing first with the psychology of the situation, he declared that the engineers' own view-point is wrong. As a class they have confined themselves so exclusively to their purely technical work and interests that to a very great extent they have become mere technical tools of the business men in control, to be taken up or laid down at pleasure.

Engineers are not consulted as a rule on the fundamental features of projects, but have become and are very largely servants, merely, instead of directors. In this connection the speaker instanced the fact that on the railroad systems the highest positions are seldom filled by men from the engineering staff, although frequently men from the ranks in the operating or clerical branches attain to the most responsible appointments. The fault, the speaker repeated, is that of the engineers themselves, who in their interest in purely technical matters have neglected to secure the business knowledge and training which is an essential qualification for responsible executive positions.

In addition, however, to training on these definite lines, effective publicity is necessary, Mr. Lewis proceeded. This is not to be obtained by direct means, or by the rather obvious attempts at personal publicity consisting of notices of arrivals and departures in the daily press, and such rather petty publicity, but more or less indirectly by taking part in public life and thus making their influence and special knowledge felt.

Engineers' Club Being Formed

The speaker described one step in this direction which is being taken by the engineers of British Columbia. An engineers' club has been formed, of which all members of the professional engineering association are automatically members. Frequent luncheon meetings are to be held, at which questions of general interest will be discussed, and a point will be made of securing speakers and guests from other organizations—boards of trade, Rotary Clubs, etc. whose interests are for the advancement of public welfare. A necessary corollary of this is, however, that engineers exert themselves to express their views and fight against the tendency to become altogether inarticulate.

A third point made by Mr. Lewis in his address was the advantage to be gained by the establishment of reciprocal arrangements between the various provincial engineering associations and between these and similar associations in the United States. A gradual linking up of this kind, in the speaker's opinion, would be a most excellent thing for the profession, and would tend more than anything else to raise the standard of professional attainments and develop a powerful national or international organization. Negotiations are already in progress towards reciprocity between the association of British Columbia and that of the State of Indiana, and it is expected that similar arrangements with other states will follow shortly. These agreements, if consummated, will make it legal for engineers of either association to practice in the others' territory on simply registering their names with the licensing authority.

Chimney Construction

Woodwork should never be built into a chimney wall nor be permitted to touch a chimney; a separation of approximately two inches should be strictly required. This applies to all floor construction, partitions, rafters, roof boards, and shingles. Where a chimney passes through a floor, the space between, the floor timbers and the chimney should be filled with some loose incombustible material, such as cinders, refuse plaster or mortar, held in place by a sheet of metal nailed to the under side of the wooden beams. The space should not be filled with solid mortar or brickwork, since this will transmit heat. Gypsum blocks, sawed to fit the space, constitute one of the best materials for this purpose. At the roof line, sheet metal protection set into the joints of the brickwork and overlapping the roof boards should be used.

There are two reasons for filling the space between the chimney and the woodwork;

1. It prevents a fire, originating on a lower floor, passing up behind a partition or furring surrounding the chimney into upper stories or the attic.

2. It avoids the possibility of rats or mice building nests in these spaces thus filling them with highly combustible material, which in time may be ignited from heat transmitted through the chimney wall. Woodwork is frequently ignited in this way.—From "Fire Control."

Motor Freight Haulage

(Continued from page 661)

cent per gallon. Later on, the whole district was gridironed with either high class concrete or well gravelled roads usable with a big load the year round. Then the gasoline vehicle arrived and took the business at one third of one cent per gallon and made money on the free highway. Thus a reduction of fifteen hundred per cent in the haulage charge in a period of fifteen years was obtained and the number of cows have increased from 2,000 to 35,000 each giving much richer milk and double the amount, for scrubs are no longer kept.

The Contract Record's

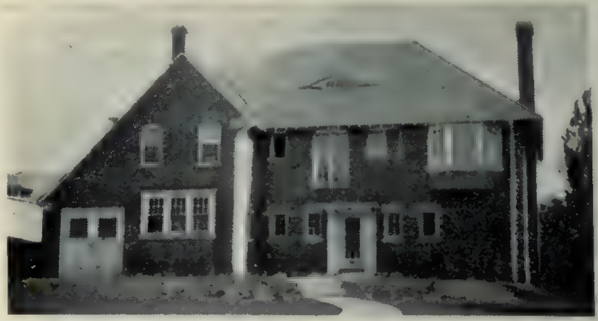
Weekly House Suggestion No. 25

The handsome residence we are showing this week was constructed for Mr. Howard T. West, on Inglewood Drive, in the Moore Park district, Toronto. It was especially designed for its ideal location overlooking Reservoir Park at the rear, the living quarters being located on this side of the house, as may be seen in the accompanying plan of the first floor, while kitchen, pantry, cloak room and garage are situated well to the front of the house.

The exterior construction is of Wagstaffe's special, blue overburned brick, with stone trim around windows and doors, red tile floor on entrance platform, and wooden shingle roofing. The garage, as seen in the illustration, is built in the east wing of the house, adjoining the kitchen, with driveway directly on Inglewood Drive.

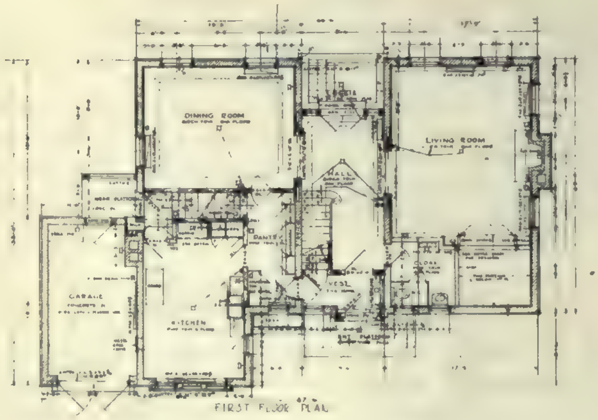
The interior requires very little discussion, the reproduced plan being exceptionally complete in equipment detail. The small section in the north-west corner of the ground floor, that is immediately next to the cloak room at the head of the living room, is now occupied by a built-in organ, though this is not shown on plan. The kitchen and pantry contain every modern convenience for the saving of labor and the wiring system is extended to every nook and corner of the house.

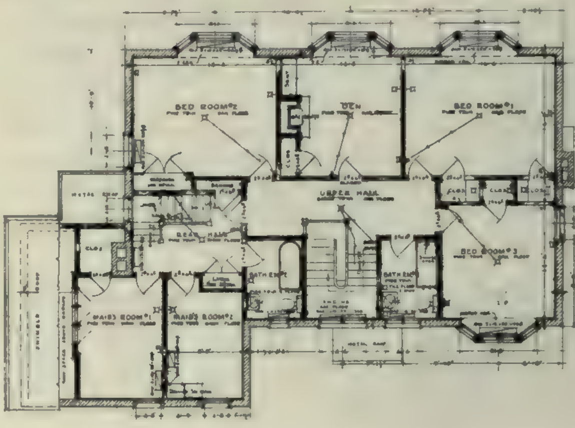
The bedroom floor, as seen on plan, is carefully designed, all rooms being conveniently situated off the large hallway. The two main bedrooms and den are situated along the rear of the house, enjoying the beautiful southern exposure on the park. The maid's quarters are located over the kitchen and garage at the end of the house and are reached by a separate stairway from the pantry on the ground floor. There are two large bathrooms, one on either side of the main stair well, as seen on plan, the one to the left serving the help's quarters. Plenty of closet space is provided in connection with all bedrooms.



The heating system of the house is of the hot water type.

This beautiful residence was designed by Messrs. Molesworth, West & Secord, 43 Victoria St., Toronto.





Large Units for Sumas Reclamation Scheme, Kilgard, B. C.

A contract for four centrifugal pump units of exceptionally large size has been secured by the Dominion Engineering Works, Ltd., of Montreal, in connection with the Sumas dyking and reclamation project now under construction near Chilliwack, B. C. The contract price is about $115,000.00, and the installation is to be complete by March 31st, 1923.

The four main units are to be of the vertical type with motor direct connected, and will be of a new pattern, known as the "Moody Spiral Pump," which gives remarkably high efficiencies on low head work, for which it is especially adapted. Two of the main pumps will be fitted with 1250 horse-power, two-speed induction motors, and the other two will have 585 horse-power, three-speed induction motors. All are of 54-in. diameter.

Accessories will include a motor driven priming pump and piping, and a motor driven sump pump outfit complete. The electrical equipment is to be of Canadian Westinghouse manufacture, and in addition to the motors will include a 500 kv.a. synchronous condenser. A ten panel switch-board will be provided for the controls and instruments. Power will be obtained from the lines of the British Columbia Electric Railway Co. Ltd.

Mainly Constructional

East and West—From Coast to Coast

Regina is having a busy building season, new buildings to the value of $325,685 having been started during the month of June, a large percentage of which were residences.

The $100,000 by-law for an extension to the collegiate institute at Galt, Ont., has been passed and it is expected that actual construction work will shortly be under way.

Damage to roads and highways in New Brunswick by the recent flooding of the Restigouche and Upsalquitch rivers is estimated at $200,000, by Hon. P. J. Veniot, Minister of Public Works of the province.

The estimated expenditure on roads in York Township, Ont., for the present year is $194,000, made up as follows: road construction, $52,000; bridge construction, $20,000; machinery, $1,000; superintendence, $2,800, and maintenance, $118,200.

A recent statement is to the effect that the brickyards at Port Credit, Ont., which have been closed down for the past two years, will reopen as soon as the plant can be put into running order. The reopening of the plant this year is due to the extra heavy demand this season for pressed brick.

The private bill introduced by Mr. W. M. German, M.P., at Ottawa recently, to incorporate the Buffalo & Fort Erie Bridge Company, who intended erecting a new international bridge at Fort Erie, has been rejected. The government, however, has signified its intention to reconstruct the present international bridge at Bridgeburg, Ont., along larger lines.

A. by-law authorizing the expenditure of $495,450 for the construction, repair and maintenance of roads in Essex County, Ont., during the present year, was passed at a recent meeting of the County Council held in Windsor. The money will be divided as follows: $109,950 for repair and maintenance and $385,500 for new construction.

The town of Tecumseh, Ont., has purchased the water works plant which supplies the town, from the Eau Claire Water Works Company, the private company who have hitherto operated it. The purchase was authorized recently by a bylaw, the cost of the plant being $60,000. The town intends constructing a new filter plant in connection with the system, which will cost about $8,000 or $9,000.

It is rumored that Montreal is to have a 10-storey building at the corner of Sherbrooke St. and Guy St., which will be occupied by business and professional offices. This building has been contemplated for some time, but owing to certain existing residential restrictions, a start has been delayed. The latest report, however, states that the city council has decided to grant the permit.

At the recent annual meeting of the British Empire Steel Corporation, at Montreal, the directorate of the company was increased to fifteen, the following new members being elected: Hon. C. P. Beaubien, Hon. Viscount Furness, Sir Trevor Dawson, Major-General Sir Newton J. Moore, K.C. M.G., M.P., Rt. Hon. Lord Invernairn, Hector McInnes, K.C., Dr. W. L. McDougald, Frank Ross, J. F. M. Stewart and Benjamin Talbot, J.P.

A movement is on foot in Western Canada, inaugurated by the Western Association of Building Industries, to forestall the serious unemployment conditions that prevail upon the closing down of construction activities in the fall. The above associations has issued an invitation to several large organizations to take part in a conference to discuss and devise some way of meeting the unemployment situation this fall.

The Toronto representatives in the House of Commons, Ottawa, waited upon Hon. J. H. King, Minister of Public Works, recently, to urge the inclusion of a $200,000 item in the supplementary estimates for the construction of another 1,000 ft. of sea wall along the shore of Centre Island, Toronto, to the west of the existing 1,700 ft. of protecting wall, for the protection of property on the island from storms.

The Queen Victoria Niagara Falls Park Commission will undertake the extension of the famous Victoria highway to Queenston this year. When completed, the boulevard will run from Fort Erie to Niagara-on-the-Lake, the full length of the Niagara River and will be one of the most beautiful drives on the continent. There will be a small section near the Hydro forebay which it will be impossible to put into condition until hydro construction work at this point has been further advanced.

Personal

Mr. St. George Boswell, chief engineer of the Quebec Harbor Commission, recently tendered his resignation which was accepted by the commission. Mr. Boswell has been 46 years in the service of the commission, and will be retained on the staff as consulting engineer. He is succeeded by Brig.-General T. L. Tremblay, who will continue in office as a member of the commission, and at the same time will act as chief engineer and general manager of the harbor.

Trade Incorporations

Monarch Wire Products, Limited, with head office at Montreal, capital $80,000.

CONSTRUCTIONAL ACTIVITY

Period of June 28 to July 4, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Brooke Twp., Ont.

L. L. Lindsay, Inwood P. O., will receive tenders until July 8th for new drains and improvements for Brooke Twp. Council. A. S. Code, Engr., Alvinston, Ont.

North Vancouver, B. C.

Plans are being prepared for storage reservoir and watermains to cost $60,000 for North Vancouver Municipality.

Guelph, Ont.

Domestic trunk sewer costing $43,195 is being constructed on Waterloo Ave. by City Council, work by day labor. F. McArthur, Engr.

St. Catharines, Ont.

City Council plan construction of pavements, sidewalks and sewers on several streets. W. P. Near, Engr.

Toronto, Ont.

Mayor C. A. Maguire will receive tenders until July 11th for laying and jointing water pipes on 5 streets for City. Plans at Room 320, City Hall.

Waterdown, Ont.

Suburban Area Cmsn., Court House, Hamilton, will finish Waterdown road with tar at cost of $15,666 per mile.

York Twp., Ont.

Frank Barber, Engr., 40 Jarvis St., Toronto, has plans and will receive tenders until July 8th for construction of concrete sidewalks on several streets for York Twp. Council.

CONTRACTS AWARDED

Mont Rolland, Que.

General contract for construction of steel penstock for Rolland Paper Co., 142 St. Paul St., Montreal, is awarded to Walsh Plate & Structural Works Ltd., 20 St. Nicholas St., Montreal.

Niagara Falls, Ont.

General contract for construction of bituminous penetration road costing $60,000 for Suburban Area Cmsn. is awarded to McRae, Campagne & Cook, Bampfield Block. Ross & Scott, Engrs., McCaw Block, Welland.

North Easthope, Ont.

Twp. Council awarded general contract for construction of drainage system to T. Kelly, Sebringville P.O.

Quebec, Que.

Dep't. of Roads, Prov. Gov't., awarded following contracts for roadwork on Quebec-St. Anne de Beaupre Highway: Beauport Brewery Bridge to Montmorency Falls Bridge, Terminal Construction Co. Ltd., Roy Bldg., Halifax; Montmorency Bridge to Boischatel, Laganiere & Houde, Grondines; L'Ange Gardien, Universal Contractors Inc., Montreal; Chateau Richer to St. Anne, F. E. Rousseau Ltee, St. Valier St., Quebec.

Toronto, Ont.

Contract at $21,823 for paving Kingswood Rd. for City has been transferred from the Commr. of Works to the Warren Bituminous Paving Co., 54 University Ave.

Walkerton, Ont.

General contract for construction of pavement costing $65,000 for Town Council is awarded to Warren Bituminous Paving Co. of Ontario Ltd., 54 University Ave., Toronto. Fred B. James, Engr., Walkerton.

Welland, Ont.

Contract at $9,400 per mile for 2½ miles of roadwork, Sec. F, for Welland County Council, is awarded to Canadian Engineering & Contracting Co., 72 James St. N., Hamilton. Contract at $15,000 per mile, 5 miles, Sec D, is placed with Law Construction Co. Ltd., 107 Hillsdale Ave., Toronto.

Railroads, Bridges and Wharves

Chimney Corner, N. S.

R. C. Desrochers, secy. Pub. Works Dep't., Dom. Gov't., Ottawa, will receive tenders until July 18th for breakwater and wharf extension. Plans with Dep't., Dist. Engr., Halifax, and Post Office, Chimney Corner. Accepted cheque for 10% of tender required.

New Westminster, B. C.

Erection of warehouse costing $10,000 is contemplated by C. N. Rlys.

St. Maxime de Scott, Que.

Town Council contemplate paving metallic bridge at cost of $10,000. L. A. Gosselin, secy.-treas.

Toronto, Ont.

H. H. Couzens, Gen. Mgr. Toronto Transportation Cmsn., Yonge and Front Sts., will receive tenders until July 10th for construction of addition to Eglinton Ave. car barns.

Vancouver, B. C.

Plans are prepared for railway to cost $80,000 for Vancouver Harbor Bd., 712 Pender St. W. W. D. Harvie, secy.

CONTRACTS AWARDED

Coquitlam, B. C.

General contract for construction of of bridges costing $45,000 for Prov. Gov't. is awarded to Hodgson, King & Marble, 508 London Bldg., Vancouver. Steel contract is placed with J. Coughlan & Sons, ft. Columbia Ave., Vancouver.

Halifax, N. S.

Nova Scotia Tram & Power Co., Barrington St., awarded general contract for concrete block paving on tracks on several streets to Stockley Construction Co., Pepperell St.

St. Anne des Plaines, Que.

General contract for construction of iron bridge costing $13,970 for Town Council is awarded to A. Charbonneau, St. Anne des Plaines.

St. Louis de Terrebonne, Que.

Louis Lauzon, St. Louis de Terrebonne, has general contract for construction of steel bridge costing $10,745 for Town Council

Public Buildings, Churches and Schools

Brantford, Ont.

B. I. Leggett, 199 Terrace Hill St., has plans and will receive tenders, no closing date set, for erection of church to cost $20,000. J. F. Brown, architect, 105 King E., Toronto.

Montreal, Que.

Erection of church is contemplated by St. Thomas Aquinas Parish. Rev. T. F. Hefferman, 124 Convent St.

St. Jeanne D'Arc Parish, 861 Chambly St., plan erection of church and presbytery on Nicolet St.

Portage La Prairie, Man.

Duncan C. Scott, Deputy Sup't. Indian Affairs Dep't., Dom. Gov't., will receive tenders until July 21st for alterations to school and principal's residence. Plans with Indian Offices, Winnipeg and Portage La Prairie, and Dep't., Ottawa. Accepted cheque for 10% of tender required.

Port Colborne, Ont.

N. A. Kearns, architect, Temple Bldg., Welland, is preparing plans for parish hall to cost $25,000 for R. C. Congregation.

Provost, Alta.

Hon. Dr. W. H. Sutherland, Deputy Min. Pub. Works Dep't., has plans and will receive tenders until July 17th for general, plumbing, heating and electrical contracts for dormitory bldg. and dining hall.

Renfrew, Ont.

S. T. C. Chown, Chrm. Bd. of Education, has plans and will receive tenders until July 18th for sub trades required for erection of collegiate institute to cost $200,000. Plans also with S. B. Coon & Son, architects, 4 St. Thomas St., Toronto. Guarantee Bond for 50% required.

St. Alexis de Matapedia, Que.

School Bd. contemplate erection of school. A. P. Arsenault, secy.

St. Ambroise, Que.

Parish will erect church and sacristy costing $100,000. Private tenders were

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U.S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, July 12, 1922 No. 28

New Construction on the Upgrade

During June, construction contracts awarded in Canada, according to MacLean Building Reports, Limited, amounted to $35,620,400, compared with $34,827,300 in May, and $26,436,800 in June, 1921. This replaces the May total as the second largest monthly figure on record since May, 1914. Residential building accounted for 36.4% of the June total, and amounted to $12,985,900. Business building amounted to $10,351,200, or 29.1% of the total; industrial buildings $4,914,300, or 13.8%; public works and utilities $7,369,000, or 20.7%. The value of contemplated new work reported during June was $26,117,400.

During May the wholesale price index of 48 building materials advanced slightly and is now 79.3% above 1913, compared with a peak of 183.8% reached in May, 1920. Prices have now declined 36.8% from the high. This seasonal upward movement will be more marked for June. Actual quotations secured in Montreal, Toronto and Winnipeg, show a decided stiffening in certain lines due to shortage in supplies, the increases representing premiums being offered and paid by builders for early delivery.

Lower freight rates on basic commodities are promised by the railroads. This should mean another decided declension in prices in the fall—which will go a long way towards maintaining the present activity which makes building the livest industry in the Dominion to-day.

Standards for Road Material

In view of the fact that asphalt and asphaltic roads have been in use for many years, and that consequently the material can hardly be said to be in any sense in the experimental stage, except in so far as all materials and methods of construction are subject to development, it is somewhat remarkable that there is apparently no single authority which can be accepted as a standard of reference as to the physical requirements of the various materials entering into this class of work, and the methods to be used in making the necessary tests of fitness.

The following clause from the standard specification for asphaltic concrete issued by one of the provincial governments illustrates this condition forcibly.

> Sec. 6, METHODS OF TESTING. Methods of testing shall be as follows:—
>
> (a) Per cent of wear of rock—standard test D2-08, American Socitey for Testing Materials.
> (b) Screen test of coarse and intermediate aggregate in wearing surface—standard method D18-16, American Socitey for Testing Materials.
> (c) Sieve test of fine aggregate and mineral filler in wearing surface—standard method D7-18, American Society for Testing Materials.
> (d) Physical and chemical properties of asphalt cement.
> I. Specific Gravity, U. S. Dept. of Agriculture Bulletin 314, p. 5.
> II. Flash point (open cup) U. S. Dept. of Agriculture, Bulletin 314, p.17.
> III. Penetration, A.T.S.M. standard test D5-16.
> IV. Ductility, Trans. A.S.C.E. Vol. LXXXII, 1918, p. 1460.
> V. Volatilization Test, U. S. Dept. of Agriculture, Bulletin 314, p. 19, using 50 gram sample.
> VI. Bitumen soluble in carbon tetrachloride. U. S. Dept. of Agriculture, Bulletin 314, p. 30.

In this clause reference is made to three standard tests of aggregate which have been drawn up by the American Society for Testing Materials, but the tests for the asphaltic cement are drawn from three separate sources and can only be obtained by reference to U. S. Government bulletins and the transactions of technical societies, volume and page numbers being given for this purpose.

While these publications and the tests described are doubtless quite well known to chemists and engineers who are closely connected with such work continuously, it would seem to be undoubtedly in the interests of efficiency and good road construction to have the details of all necessary tests for road building materials collected and published in concise form so as to be available for the use of all interested in road building without the necessity of research and annoying delays.

It is also somewhat of a blow to national pride to find that the nine tests prescribed in this extract from a Canadian specification are quoted from purely U. S. sources. The development of tests and fixing of standards is a work of constructive engineering which could well engage the attention of our Canadian engineering societies and of the Bureau of Standards. These bodies have already done good work on the lines suggested, but there appears to be still something lacking, either in the scope of the work undertaken or in the amount of publicity given to its results when clauses like the one quoted appear in Canadian specifications.

The Vancouver Bridge Project

Considerable significance attaches to the circumstances surrounding the revival at this time of the Second Narrows Bridge project at Vancouver, B. C. There is said to be good prospect of an early start on the construction of this long-delayed scheme, and its consummation will have the effect of practically doubling the extent of industrial waterfront available.

The scheme is a large one and of considerable engineering importance. It will involve difficult problems of sub-structure, and approaches will have to be arranged for under circumstances which will add considerably to the cost of the work. A further complication is the fact that serious obstruction to the passage of ships to the upper waters of Burrard Inlet could not be permitted, which means that a quick-acting swing or bascule span will necessarily be included in the plans.

The encouraging feature in connection with the new proposal ts that American capital is once more evidently on the look-out for opportunities of investment in this country. This in itself would indicate that the period of uncertainty and stagnation which has gone with post-war readjustment is practically over, and that the country is on the high road to a new and more solid prosperity than ever.

We cannot but value proof of this kind that outsiders share our own belief in the business prospects of the country, but at the same time it will be a pity if the opportunity furnished by returning prosperity is neglected by our own people. A greater tendency to invest in home projects would not only have the effect of keeping profit at home to a larger extent, but would also prove a great incentive to the foreign investor, in the cases where the use of resources beyond local compass is essential to progress.

Railway Centre at Vancouver is Scene of Extensive Improvements

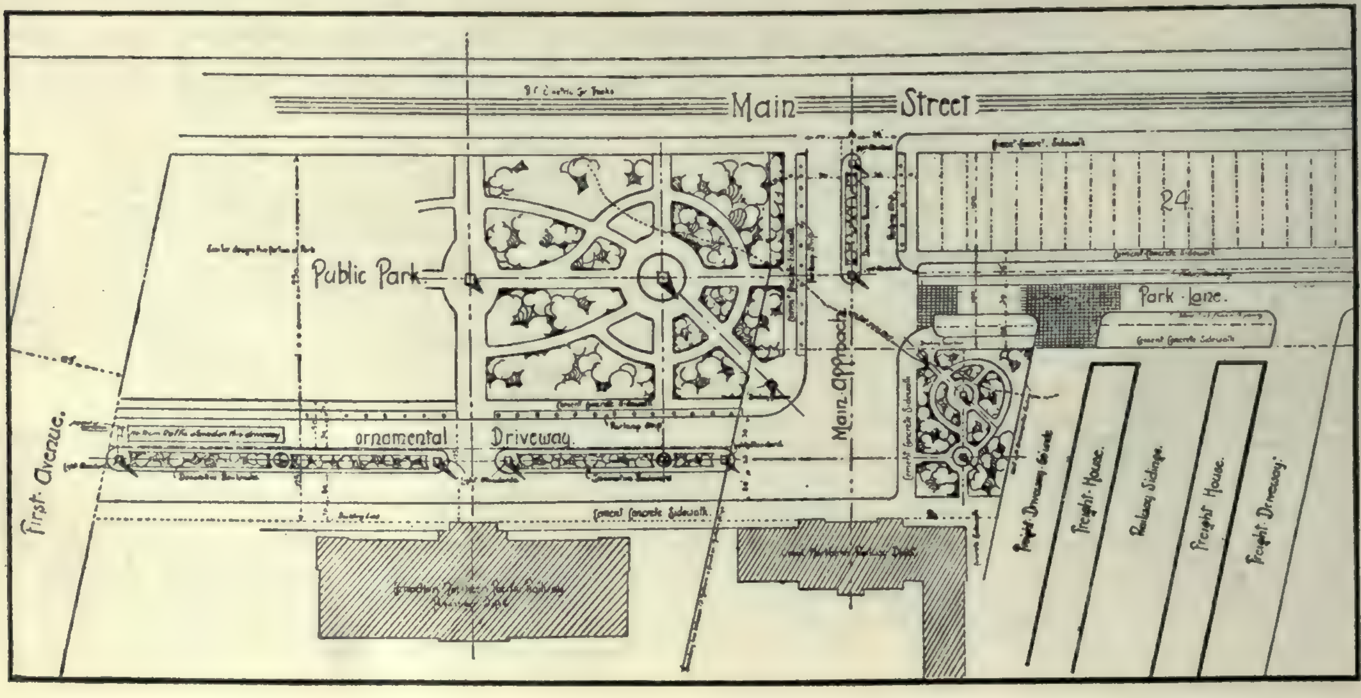
By the Contract Record's Pacific Coast Correspondent

An elaborate approach to the Canadian Northern and Great Northern railway station is being planned in connection with the work now being carried out by the city of Vancouver on the re-grading of Main Street, which was discribed in a recent issue of the "Contract Record."

An approach from Main Street to the entrance of the depots, with a decorative park strip in the centre, is the first item of the plan as proposed and approved by F. L. Fellowes, city engineer, the boulevarding being carried as far as the junction of the approach road with First Avenue. Two public parks in front of the station, divided by the approach road, are also part of the ultimate scheme, and are shown on the plan. A formal layout, with curving walks, an extensive floral display, drinking fountains and benches, is proposed.

The work now in progress is still preliminary to the scheme of beautifying here described. Street railway tracks are being laid across the new grade, which has recently been completed by dredging material from the False Creek basin. The entire area is now brought up to grade and the concrete docks, drains and subsidiary works completed or approaching completion.

A feature of the development is that on this portion of Main Street all telephone lines are being laid in conduit underground, this work now in progress simultaneously with the track construction and grading work.



The Engineer's Place in the Planning of Towns and Cities

Too Little Thought Has Been Given to the Problems of Town Planning by Municipal Engineers — What Is Involved in Town Planning

By JAMES EWING, M.E.I.C.

Before the Western Professional Meeting of the Engineering Institute of Canada

The actual planning of towns and cities is a science to which municipal engineers as a rule have given far too little thought and attention, notwithstanding that it is the main governing and determining factor in their work.

In the West especially, the pioneer influence of the railways is the prime initiator of the town and the city, and railroad economics, exigencies and requirements, the paramount consideration. With the railway station as the nucleus of a rudimentary rectangular layout, the town is started off to grow and take care of itself in growing.

Then the real estate operator gets to work and takes a hand in the movement. Such notions as the development of the land to the best advantage and accommodation of the community are usually foreign to him. He is not interested in holding and improving the land, but only in getting rid of it, receiving the biggest turnover in the shortest possible time. Therefore all economic, hygienic or aesthetic considerations are entirely outweighed by the easiest and cheapest layout that can be obtained.

And when the town grows apace and aspires to the status of a city the services of the municipal engineer are commissioned and in nine cases out of ten he accepts and falls in with the existing situation unquestioningly. He applies his knowledge and energies assiduously to determining the most efficient and economical design and construction of the necessary public utilities; he is most careful and painstaking regarding the source, distribution and treatment of the water-supply, the correct grades and capacities of the sewerage conduits as well as the ultimate disposal of the sewage, and the proper ingredients, handling of materials and most durable types of street paving.

The basic question, however, of what a street is for, is seldom or ever entered into analytically; the present and prospective volume of street traffic is usually disregarded, and the general development along rational and economic lines left uncontrolled until it becomes practically uncontrollable.

Where the Blame Lies

Perhaps it is hardly fair to put the blame on the engineer who, generally speaking, is asked to study and advise on certain phases of the subject and is paid for that, while unsolicited recommendations would be unappreciated and possibly even resented. The fault lies rather with the authorities who employ him, or with the taxpayers themselves who are always urgently clamouring to see something tangible for their money, but the misfortune falls on the entire town, which forever after must go on struggling under disabilities which might easily have been obviated in the beginning.

The great trouble is that the need for town planning is never imperative and seldom ever apparent until its cost becomes prohibitive. And it is only after most of the damage has been done, when the water and sewerage systems have been installed, pavements laid, tramways constructed, and many more or less valuable buildings erected that the inherent weakness and sheer inadequacy of an ill-considered rule-of-thumb layout becomes evident.

It will then be found in most cases that the main streams of street traffic have to follow indirect routes over thoroughfares of insufficient capacity, with the principal crossings blocked and congested, notwithstanding the fact that at the same time there are plenty of other streets of extravagant width over which there is no traffic to speak of, and where it may be said that fifty per cent of the cost of paving those streets has been both literally and figuratively money thrown in the gutter. Then too, the perilous and paralysing effect of the level railroad crossing assumes prominence, becoming a real calamitous condition calling loudly for redress.

The Development of Slums

Soon also we find, owing to unregulated and uncontrolled development, the factories springing up promiscuously all over the place and spreading in their neighborhood ugly, malodorous and grimy conditions, forcing up the cost of land but depreciating residential values with the inevitable consequence that buildings fall into disuse, decay and dilapidation, and the foul, reeking, cankerous, slum is created. Following upon that a well defined movement is instituted from the centre towards the circumference of the city, first of the residences seeking more wholesome surroundings, followed by the shopping and lighter industrial establishments, and last of all by the factories themselves, which, finding themselves cramped for elbow room and bereft of a nearby steady and reliable labor supply, start to get after it and begin to build up on the outskirts, there to create afresh new plethoras of slums.

In this way a huge volume of really unnecessary street traffic is formed, under which the pavements soon crumble and have to be renewed only to be torn up again in order to install larger and more adequate water, sewerage, and power services to meet industrial requirements. Main thoroughfares must be widened at tremendous cost or new traffic avenues opened up. Building, tearing down and rebuilding becomes the order of the day, and so goes on the everlasting merry-go-round which leads nowhere, for the cycle is never completed. It is a constant, ever-widening spiral, following along in a blind way without objective, and the waste is tremendous, the lost and dissipated effort incalculable.

With all the talk about town planning in recent years its real purpose is quite commonly misunderstood. The most widely prevailing and persistent misconception is that it has mainly to do with "frills," and it is linked up in the general mind with ambitious schemes of embellishment, stately and imposing civic centres, elaborate and extravagant boulevards, and parks and plazas resplendent with foliage, fountains, and monuments. Now it should be clearly recognized that these things, however nice in themselves, are neither of major nor urgent moment, and if they come into it at all they are merely incidental. And it should be remembered that a city may have all of these things and yet be organically poorly planned, indeed some of them are often in themselves conspicuous examples of radically bad planning.

The transportation or street traffic problem is of basic importance. And here it may be said that one could well imagine what would happen to the human body if all our veins, instead of being proportioned according to the amount of work they have to perform, into main arterial, secondary and minor distribution systems, were all about the same size. No engineer worthy of the name would think for a moment of designing water and sewerage services with pipes all of one dimension, and yet in making provision for our street traffic that is exactly what we do with our streets.

At the root of the traffic problem lies the railroad transportation question, and it is all the more important because it is the rigid framework affecting and governing all the rest. In the West more especially, the railways have the advantage usually of having got there first, or at least one of them has, and if the town shows any disposition to grow or become a progressive centre, we may be quite sure that other competitive roads will follow, each, of course, wanting to come in over its own right of way, and generally at about the same level as that of the streets.

How the Railways Paralyze Traffic

And so we frequently find these rival roads with their subsidiary and connecting spurs forming together a regular network of tracks paralyzing the street traffic and compressing the very vitals of the city in a grip of steel. It is futile to expect any healthy, vigorous movement or progress under conditions like that since what should be designed as useful and helpful adjuncts, each of the other, are in perpetual self-destructive conflict.

Railway transportation in the city is therefore the primary problem confronting the town planner, and the unification of road-beds if not of tracks, as well as the separation of grades to the greatest possible extent is of the utmost moment.

Zoning

Next to the railroad transportation question is the problem of zoning, or "districting" as some prefer to call it, in such a way as to afford protection to the residential element and at the same time give the utmost facility for the carrying on of manufacturing industrial and commercial operations, for these are the bones and sinews of the city corporate, without which it could only hope for a flabby and ephemeral existence.

We have observed the deleterious effects of allowing factories to spring up anywhere and everywhere, noticeably wherever they can find the cheapest land. They should be confined to districts close and convenient to the lines of railroad and water communication. It will be seen at once that this will reduce to a minimum the heavy cartage and the consequent destruction of street paving. This cartage should be guided along main thoroughfares specially constructed to be able to withstand it, affording corresponding relief and saving to the streets in the other portions of the town, where the paving can be of the lightest nature at the least cost.

By keeping the factories together in districts by themselves special provision can be made for giving them in economical and concentrated form all the facilities for carrying on their work—ample water, sewerage, lighting, heating, and power services, as well as special fire protection. This, too, affords corresponding relief to the other districts where these utilities need only be such as are requisite for domestic requirements.

That the sanctity, reserve and amenity of the home should be held inviolate as a retreat from the turmoil and tumult of the day seems a truism, and for that reason purely residential sections should be created and kept free from invasion of industrial and business concerns.

Even if there were no other benefits, the stabilizing and enhancing effects that this zoning has upon land values is one that cannot be lightly estimated, and might be graphically represented by a gradual upward curve, instead of by a series of sharp fluctuations indicating periods of feverish speculation and inflated values, followed by subsequent reaction and depression.

Streets Should be Graduated

To provide efficiently and economically for the flow of traffic the streets should be proportioned and graduated according to the service they are called upon to perform, with due regard to the future. Main thoroughfares should be direct routes, and for that reason, if for no other, the rigid rectangular layout is wasteful and inadequate in a town aspiring to any greatness.

In residential sections all through traffic should be as much as possible discouraged. The streets may be laid out winding, with occasional breaks, and the roadway should only be of such width as to accommodate merely local traffic. The building line should be set back to ensure provision for air space, and a sincere endeavor made to emulate a parklike appearance.

The advent of the automobile and the heavy motor truck has revolutionized the problem of street traffic and the paving of streets, creating not only an excessive volume of traffic hitherto undreamt of, but exercising new destructive forces on paving. The street parking problem and the question of the ubiquitous garage are also assuming such proportions as to become a real public menace, requiring not only regulation, but special provision.

Since it will be found that most of the congestion of traffic in our main thoroughfares occurs at the principal crossings the corner curbs of these should be well rounded in order to facilitate the digestion of accumulated traffic, using a radius of not less than 25 feet, which is equivalent in its effect to widening a street 10 feet throughout. The ordinary radius for less important crossings should be 15 feet, which is the minimum radius in which an automobile can turn and remain normal to the curb. In cases of extreme congestion circles should be provided to afford the necessary easement.

Parks and Playgrounds

The matter of parks and playgrounds is one of the most essential conditions of health and well-being: these are the lungs of the city. Their ample provision and convenient and equitable distribution is of vital moment. They should be acquired well in advance of building development before increasing land values have rendered their acquisition prohibitive.

It is not sufficient to have a few isolated patches of ground to be used as parks; there should be a regular park system, linked up with tree shaded driveways. From a commercial and money-making point of view, if for nothing else, this is a splendid investment, for we should not fail to remember that it is the well dressed shop window that catches the customers.

Piecemeal Planning

A word of warning must be uttered against piecemeal planning, carrying out isolated bits of street widening or extension, a park here and a boulevard somewhere else, according to no well-defined scheme or purpose. It is about the best way to get the least benefit from the money that one can possible think of, and unfortunately it is just the kind of planning that appears to have the strongest appeal to the average civic mind. Equally delusive in its inception as it is disappointing in its results, and invariably ending in a hopeless muddle, it is the greatest deterrent to all future sound and well considered planning or effectual improvement.

To get real results the whole question must be tackled and studied in a comprehensive way, giving careful heed to all the factors in a city's development, each being indissolubly linked with the other. When a good general plan is prepared there is a clear objective to work up to in a systematic way. It by no means follows that it must be carried out all at once, but only step by step as occasion warrants and means can afford.

To do nothing and let things take their course unguided and untended is in the long run the costliest way of all, and there is nothing left to show for it but a poor inheritance of everlasting trouble, inconvenience, stunted growth and lowered vitality in the community.

There are, however, other things in life than can be measured by mere monetary standards—good health, the joy of living, a fine communal spirit, and a just pride in being "citizens of no mean city," and these are after all the only things that are really worth while.

What Are the Prospects in Building?

How Costs Are Likely to Change—Stiffening of Material Prices—Bidding for Labor—Full Operation of the Law of Supply and Demand

By **MORTON C. TUTTLE**

General Manager, Aberthaw Construction Co., Boston

It will be interesting to observe the next three months' development in the building trade because the increasing buying by the building trade will stimulate not only the production of building material like steel, lumber, cement, but also will have a tremendous effect upon railroad traffic. It is also worth while to watch developments in the building labor field, because the reactions in the building trade occur with almost laboratory quickness. Movements in the building market probably forecast very accurately the slower but similar movements in manufacturing, giving as accurate a forcast of the future of industrial conditions as can be obtained. If rising costs halt buying of buildings, similar results may be expected in the market of manufactured material. For these reasons it may be interesting to consider the present situation in the building trade.

Post-Bellum Prices

Following the war there was a building boom largely caused by the expansion of factories. This boom raised the cost of building until in the middle of 1920 it cost $266,000 to build a factory that would have cost $100,000 in 1915. Following 1920 came the depression, and the price of buildings dropped to 150, compared to the pre-war 100.

The falling cost of building met the rising rents late in 1920, and since that date a greater return can be obtained from rents from a new building than could be obtained in 1915. An accumulated shortage, plus the stimulation of greater rent return, has brought on a tremendous volume of home building. This home building activity is nation-wide. The dropping costs of office buildings met the rising rents precisely as in the case of the dwelling houses, and only a lesser activity has resulted in this line of work. Into this active market has also come the demand for hospitals, schools and public buildings of all sorts, and a belated programme of road building and public improvements. Building of factories during the last two years has been in very small volume. Manufacturers have been concerned with cutting down inventories, reducing expenses and searching for increased markets, and have hesitated to put money into capital expenditures.

The mechanics that follow the city building trades seldom go outside the cities on industrial work. They work close to where they live, and during the depression in the city building, these men have been frequently out of employment. Wage cuts have been accepted, and during this time of dearth of employment union men worked with at least superficial cheerfulness beside non-union men. During a depression of this sort few apprentices have been trained. The aggressiveness of the labor unions has been softened, and the employers have had a buyer's market, so far as labor is concerned. During this period the union men have assured the employers that later on when business becomes more active, there would have to be a realignment and readjustment. It seems probable that belated questions of unionism, working rules and rates will be taken from the table during the coming summer. In the face of these known conditions anyone outside the building trade would promptly suggest that the design of buildings should be changed to accommodate the shortage in certain trades. This is far easier to suggest than it is to carry out.

Building Costs

The principal elements in an office building, a hospital and school are as conventional as the trimmings of a dinner coat, and accordingly when office buildings are wanted, the demand falls on the already overloaded trades. The buyer of factories has a far wider choice of material and design than has the buyer of an office building, or even of a private dwelling house. The cost of factory construction will probably advance less rapidly than the cost of architectural work. For years before the war, building costs were on a fairly level basis. The cost of brick work and of carpentry were so stable that they became almost traditional and the estimating of work was a simple process. The varying costs of the last five years, however, have made all the old data useless,, have made it exceedingly difficult to estimate the cost of building. Even if the cost of a building can be estimated as of given date, it is difficult on a fluctuating market to project this estimate over a period of eight to twelve months. During the period of rising prices this difficulty manifested itself in the frequency with which estimates were overrun.

Following the peak we have a sharply dropping market in which it has been easy to estimate work, because the market has been constantly dropping and estimates were underrun. About the first of this year the cost of buildings reached bottom, remaining horizontal for February and March, and then began to rise until today it is safe to say that the cost of buildings has risen eight to ten per cent since the first of the year. This rise occurs in several ways—in the stiffening of prices of materials—steel, brick and cement have all risen. Lumber has not only risen in price, but the time for delivery has increased so that a shipment which was made within a week after receipt of orders requires three months for shipment, unless bonus is paid for prompt shipment. Wages are stiffening.

During the depression of last winter, there was less unemployment than was commonly anticipated during the fall. Activity in many manufacturing lines has visibly increased, and this activity has absorbed some common labor. The greatly increased activity in the building trade has absorbed still more, and this has resulted in a shortage of the better grades of unskilled labor. Limited immigration and considerable movement towards their native country of former immigrants has shortened the number of men available.

The Question of Labor

It is increasingly difficult to get men to move to distant places or to take on the less attractive forms of common labor without price concessions. The substitution of less competent labor at the same rate paid to better labor produces higher labor costs, and this process of raising labor costs on a horizontal wage scale is now under way. It is reasonable to expect this to be followed sooner or later by bidding up for the best labor. As labor becomes scarce and poorer men are substituted for better, the better men slow down to the accomplishment of the poorer ones. When bidding for labor becomes brisk, there is a further slacking down, because with the knowledge that jobs are readily available, workmen become independent and careless. In building operations these two processes of dilution of good labor gangs, plus the feeling of independence arising when bidding for labor sets in, result, without wage change, in at least a 20 per cent increase in labor cost. It is possible that this summer the Boston building trade will experience the effect of dilution plus bidding. To the manufacturer who will face the problems it will be interesting to see how the matter works out. Most city building is let on lump sum bids. The bidder is selling futures, because his operations will continue over a period of eight to twelve months, and he has based his estimate on a theoretical wage scale and labor output for this period of time.

Thus it is reasonable to expect a prompt stiffening of the wages of common labor. Certain of the building trades are undermanned, the most conspicuous case being that of the plasterers.. The plasterers' wages have already climbed and the bidding for their services is active. Only second to the plasterers come the brick masons, who like the plasterers, are selling their services to increasingly active bidding.

The Basis of Bidding

So much work is already under contract that we are likely to see the full working of the law of supply and demand carried pretty well to a conclusion in the building trade labor market. It is fairly easy to forecast that as soon as the situation is clearly recognized in the building trade the basis of bidding will rise sharply. Many contracts have been taken on the theory that wages were to remain stable, and last spring some were even theorizing about lower wages. It is easy to anticipate that there may be a scramble to recoup losses by trying for higher prices on future work. Meanwhile many bidders will be uncomfortable trying to work through operations which aggregate millions taken on a very low price basis.

The best opinion seems to be that the bottom of the building market has been passed. If on the rising market large volumes of building work continue, then manufacturers may reason that the public is ready in turn to buy of their merchandise when their prices rise. If on the other hand, the volume of contracts let sharply declines as prices rise, this will be of significance to the manufacturer and the merchant. In any case it will be interesting and profitable to follow the building market for the next few months.

Another Encouraging Sign

Canadian imports are going down—Our exports are increasing. For the month of May, 1922, the Department of Commerce figures just issued from Washington, show an improving trade condition from Canada's viewpoint. Here are the figures as compared with May, 1921, showing both an increase in exports and a decrease in imports:

	May, 1921	May, 1922	Improvement
Exports	$26,143,147	$28,249,429	$2 106,282
Imports	50,482,566	44,287,140	6,195,426

For eleven months ending May 31, 1922, as compared with the corresponding eleven months a year ago the figures are:

	1921	1922
Exports	$506,182,820	$277,251,119
Imports	$739,879,043	$497,370,292

Contracts Let for Trans-Provincial Highway in British Columbia

Two Sections to be Constructed—One of Asphaltic Concrete and the Other of One-course Concrete—Data Furnished to Contractors is Especially Complete

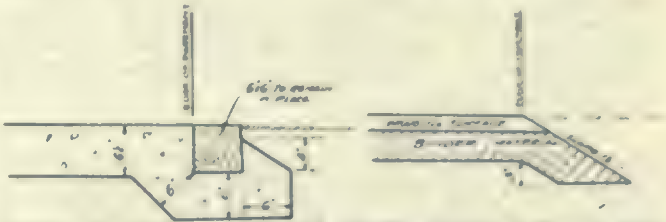
By the Contract Record's Pacific Coast Correspondent

Two contracts have recently been let by the Provincial Public Works Department of British Columbia for sections of the trans-provincial highway. These include two miles easterly from the town of Chilliwack and 2.90 miles from Johnston Road to the Serpentine Flats in the District of Surrey, about six miles from the city of New Westminster.

The first mentioned section will be constructed in asphaltic concrete, and will have a 3 inch base course of asphaltic concrete with a 2 inch wearing surface of the bitulithic type. It will have a shoulder to shoulder width of 16 feet. The Columbia Bitulithic Company were the successful tenderers. The second section will be a one-course concrete pavement of 7 inches uniform thickness and 18 feet width, and has been let to the Cotton Co. Ltd., of Vancouver, B. C.

In calling for tenders for the construction of hard surface pavements, the Public Works Department, of which Mr. P. Philip is chief engineer, issues plans showing standard sections of all the acceptable methods of construction. These include the one course concrete pavement, reinforced when necessary, as one general type, and asphaltic concrete construction, laid with binder course and a wearing surface of asphaltic concrete or some similar type.

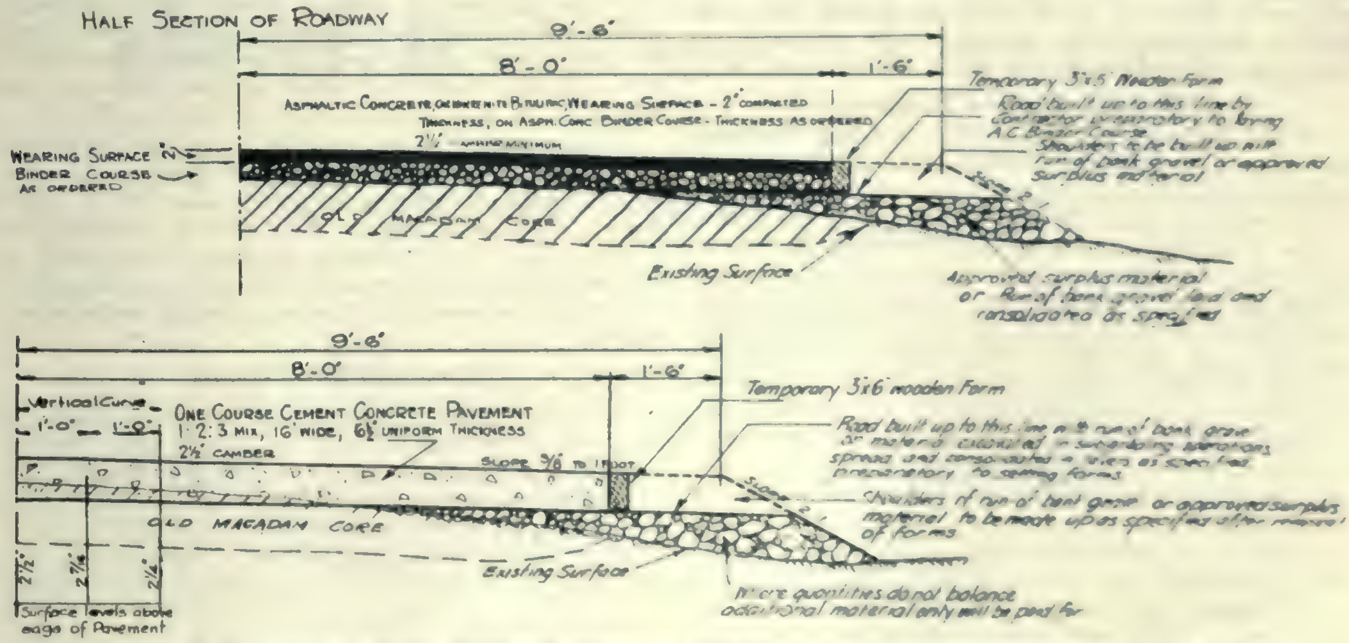
The particular arrangement of the plans prepared is quite interesting in the completeness of the information furnished. In addition to the usual set of plans and profiles, with cross-sections, a "title-page" plan is furnished, which besides showing typical sections of the finished pavements in both of the general types acceptable, gives schedules of quantities, details of the headers required at street intersections and at the end of the section under construction, and a map on a scale of one inch to the mile giving details of the country for several miles around the site of the contract. This map, with its information as to roads and communications generally furnishes valuable data for the preparation of tenders.



Headers for cement concrete and asphaltic concrete paving, at street intersections and end of pavement.

The Department has prepared a set of standard specifications which are used on all contracts. These include separate sections dealing with the preparation of sub-grade, which apply to any type of surfacing, and groups of clauses dealing specifically with the details of concrete one-course pavements on the one hand and the asphaltic types on the other.

The total value of buildings in Ontario, for which permits were let during last month, was $11,419,000.


HALF SECTION OF ROADWAY
9'-6"
8'-0"
1'-6"
Asphaltic Concrete, or Bitulithic Wearing Surface - 2" compacted Thickness, on Asph. Conc. Binder Course - Thickness as ordered
2½" minimum
Wearing Surface
Binder Course as ordered
Old Macadam Core
Temporary 3"x6" Header Form
Road built up to this line by Contractor preparatory to laying A.C. Binder Course
Shoulders to be built up with run of bank gravel or approved surplus material
Existing Surface
Approved surplus material or Run of bank gravel laid and consolidated as specified
9'-6"
8'-0"
1'-6"
Vertical Curve
1'-0"
1'-0"
One Course Cement Concrete Pavement
1:2:3 mix, 16' wide, 6½" uniform Thickness
2½" camber
Slope 3/8" to 1 foot
Old Macadam Core
Temporary 3"x6" wooden Form
Road built up to this line with run of bank gravel or material obtained in subgrading operations spread and consolidated as specified preparatory to setting forms
Shoulders of run of bank gravel or approved surplus material to be made up as specified after removal of forms
Existing Surface
Where quantities do not balance additional material only will be paid for
2½"
2¼"
2⅛"
Surface levels above edge of Pavement

Typical cross-sections of cement concrete and asphaltic co ncrete pavements for trans-provincial highway in British Columbia

Highway Bridge Maintenance Methods

Practical Suggestions for Inspection and Repair of Timber and Steel Structures—Floor Renewal—Pneumatic Paint Machines Prove Very Thorough

Some excellent suggestions on highway bridge inspection and maintenance, particularly as relates to timber structures, were given by E. J. Miller, Assistant Bridge Engineer, Minnesota Highway Department, in a recent issue of the "Improvement Bulletin," and quoted in "Engineering and Contracting." His article follows practically in full:

In order to get the value out of each bridge, when once it is built, it is very essential to have a definite maintenance policy. Our law requires that each bridge over a 30 ft. span must be inspected once annually. This, in itself, is a very good law and has a two-fold purpose: First, prevention of accidents and, second, it creates the incentive for getting a dollar's worth of use out of every dollar spent in bridge construction.

Wood bridge floors require very frequent renewals, often having to be replaced in three year periods. Wood floors and stringers are the most liable to deceive the inspector. The stringers may appear to be all right on the sides and yet may be 75 per cent rotted away in the center, leaving but a thin shell outside. This necessitates taking up at least one floor plank in each panel to find the actual condition of the stringers, unless other means are used to detect defective timber.

Testing Condition of Bridges with the Ice Pick

We have used during the past year a common ice pick with very good success in examining wooden structures. This consists of a long slender steel prod tapering to a very sharp point, which can be run down between the floor planks. It is often jabbed half a foot into a defective stringer, if rotting is well advanced. This instrument also can readily be used to prod timbers such as caps or wood piles, in order to ascertain the soundness of the wood itself. It will penetrate defective wood with surprising ease and enables one to make sure conclusions as to soundness, where the eyesight would probably be deceived.

Protecting Tops of Stringers

When renewing the wood floors on wood stringers, the tops of the stringers themselves should always have some protective coating, inasmuch as the stringers deteriorate from the top down. This, no doubt, is due to water penetrating and following the spikes down into the stringers and on account of the tops drying off last. There are several good ways of protecting the tops of stringers, any one of which may be used to good advantage. One may put on a brush coat of creosote, a swab coat of hot pitch, a coat of tar, which may be heated if it is too stiff to run properly, or galvanized iron sheets which may be placed on tops of stringers, although this method has gone into the discard on account of its cost and inconvenience in placing.

Creosote or pitch treatment on the tops of stringers is the least expensive and from investigation up to the present time is at least equal to using galvanized iron. Local conditions very often determine what one can use, as all these materials are not readily obtained in various parts of the state.

Wood Bridge Floors

I do not believe that single plank floors laid crossways are either economical or practical for present day traffic. We have had very good success with laying our sub-floors crossways and our top floor of oak 2 ins. thick laid longitudinally. This oak wearing course on secondary roads need be only 8 ft. to 10 ft. wide, but on well travelled or primary roads should be the full width of the bridge.

When using this, a sub-floor should be laid with 1/4-in. to 3/8-in. open joints, for drainage. When using on oak top floor the sub-floor should preferably be treated with creosote or hot pitch in order to retard decay. The oak wearing course itself may be coated with tar or pitch, and sanded, if desired. Such treatment will give the floor the appearance of asphalt and traffic will be perfectly noiseless when crossing it.

Tarvia Concrete Wearing Surface

Another type of bridge floor wearing course is Tarvia K P concrete. This is somewhat difficult to construct and very often makes maintenance imperative on account of not having been rolled or tramped thoroughly enough when first placed. When using this type of wearing course the wood floor, if such, should be made as rigid as possible before placing the Tarvia concrete and the wood stringers can often be made two panels in length, staggered and should be well bridged at mid-panels. The sub-floor should preferably be tongued and grooved, and if laid diagonally, using 20-ft. planks on a 16-ft. width roadway, considerable added stiffness is obtained in the floor system.

If the sub-floor is ordinary bridge plank the cracks and openings shall be thoroughly caulked with oakum or lath securly nailed and all knotholes should have tin coverings tacked on before placing wearing surface.

Only crushed stones should be used in laying tar concrete wearing course, as gravel pebbles have the disadvantage of starting to roll under direct wheel loads. Seal coats on tar floor should preferably be placed a month or two after the floor is completed as this enables inequalities to be evened up and possible ruts to be removed which have occurred under heavy travel.

Creosote Block Floors

Creosote block floors may be laid on plank or concrete sub-floor. If laid on plank the sub-floor should be tongued and grooved. Such floors are very satisfactory and have a length of life of from 10 to 15 years. It has been a matter of observation that creosote block floors have a longer length of life on a bridge than on an adjacent pavement. This is possibly due to resiliency in the bridge reducing the effect of the impact. Asphaltic concrete floors are only suitable on concrete floors and should be laid in connection with paving project.

Six Points to be Remembered When Making Bridge Inspection

Bridge inspections can be made according to no set rules. The principal object of the inspection should be to look after things that are wrong. The following general outline should be followed:

First: The condition of the floor plank and stringers.

Second: The condition of the steel with regard to rust and paint.

Third: The condition of the expansion devices.

Fourth: The condition of the railing and bridge rails, taking due regard for broken units and condition of paint.

Fifth: General strength of the entire structure. The maximum safe load which the structure will carry should be determined by this inspection.

Sixth: Recommendations for repairs and method of carrying out such repairs.

Painting Steel Bridges

It has been found that nine out of ten steel bridges require painting, since practically all bridges are forgotten once they are built. The average steel truss will have a length of life of only 20 years if no attention is paid to painting. Therefore, this phase of bridge maintenance should be very diligently taken care of. Bridges should be thoroughly cleaned of all dirt, scale, rust and old paint before any attempt is made to repaint them. A structure very badly rusted should receive a first coat of red lead and oil and then a second coat of a carbon or a graphic paint of the best quality obtainable. The old adage that "The best is the cheapest" applies with special emphasis to bridge painting.

A structure which is rusted only in spots and in local pockets should be thoroughly cleaned and scraped and such bad places touched up with red lead and oil before painting with the top coat.

Steel structures should normally be painted as soon as the protection surface begins to show signs of breaking down and rusting is about to take place. It is of special importance that all pockets, corners and grooves shall be thoroughly cleaned and painted and that they are not overlooked. "A chain is no stronger than its weakest link," and if such grooves and pockets are overlooked for several years one may find that the steel is entirely rusted through and the collapse of the structure is imminent.

The maintenance department has adopted olive green as a standard color for bridge painting and also has adopted the practice of dating all bridges by means of a stencil showing the time of the last painting. This practice of dating bridges when painting them has been customary with the railway maintenance of way departments for a number of years.

Deductions Arrived at From Use of Pneumatic Paint Machines

The Minnesota State Highway Department has operated a pneumatic paint machine during the latter part of the last season and the following deductions were made when comparing with hand painting:

First: The air brush painting has proved the most economical.

Second: Painting with air brushes proves the most thorough on account of the ease of getting into some inaccessible places. It was found, however, that it was very essential to have skilled operators on account of the difficulty of knowing just when the paint coat was applied to the proper thickness.

Bridge railings and approach rails to the bridges are being painted white on the trunk highway system for the obvious reason of reducing the possibilities of accidents and making night driving less hazardous.

During the last season the total length of 2,000 ft. of bridges have been painted and the average cost per lineal foot for all conditions was $1.12. This cost did not include interest and depreciation on equipment used.

Long Deferred Bridge Scheme at Vancouver, B. C., Now a Live Issue

Revival of Interest in a Connecting Link Between Vancouver and the North Shore of the Burrard Inlet—Group of Companies are Said to be Interested in the Project

By the Contract Record's Pacific Coast Correspondent

One of the essential links in the building up of greater Vancouver has for years been recognized to be the building of a bridge to connect Vancouver city with the north shore of Burrard Inlet, where is located the city of North Vancouver and the suburban municipalities of North Vancouver District and West Vancouver. This bridge, for which plans were made ten years ago, and construction of which has only been delayed by the war and subsequent depression, is now to be built, according to information made public by officials of the city of North Vancouver, which is perhaps chiefly interested in the consummation of the project.

A group of four companies are said to be interested in the present revival of the project, proposing to build the bridge, financing the entire undertaking, and accepting in exchange the bonds of the north shore city. Among the promoting companies are the American Iron Products Company of New York, and the McClintock, Marshall Company of Pittsburgh. E. D. O'Neill, New York financier and engineer, is in Vancouver representing the two companies named.

The North Vancouver city council, it is understood, will shortly submit to the ratepayers a by-law for approximately $1,000,000 or a little more than the amount required in addition to the contributions of Vancouver City, which is $250,000, and other smaller amounts promised by various interests.

The Burrard Bridge and Tunnel Company was formed ten years ago to handle the project, and in it were vested the interests of the various municipalities concerned. As stated, the block of stock subscribed to by Vancouver city is $250,000. Deputations to Ottawa and Victoria had repeatedly asked government aid for the project, but without sufficient success to warrant proceeding. North Vancouver, whose whole future is wrapped up in this development, appears finally to have taken the plunge on its own account, and with the various contributions already arranged for, has decided, it is understood, to finance the undertaking itself.

Provisions will be made, it is stated, for the running of street cars over the bridge, but whether there will be accommodation for the steam railways is problematical. The lack of connection such as will be furnished by this bridge has been regarded by residents on the north shore as the only condition retarding the establishment of a great chain of industries along the north side of the Inlet, which has between three and four miles of waterfront available.

Reinforced Concrete Cornice is Special Feature of Victoria Hospital

Rapid Progress on New East Wing of Provincial Royal Jubilee Hospital—Special Form Work and Reinforcing for Heavy Cornice

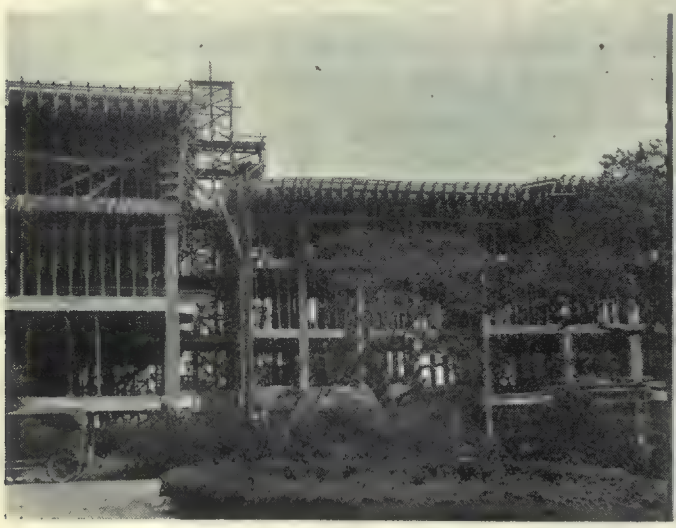
By J. B. HOLDCROFT, A.M.E.I.C.
Contract Record Correspondent

Rapid progress is being made on the construction of the new east wing of the Provincial Royal Jubilee Hospital at Victoria, B. C., four floors having been completed and the fifth under construction.

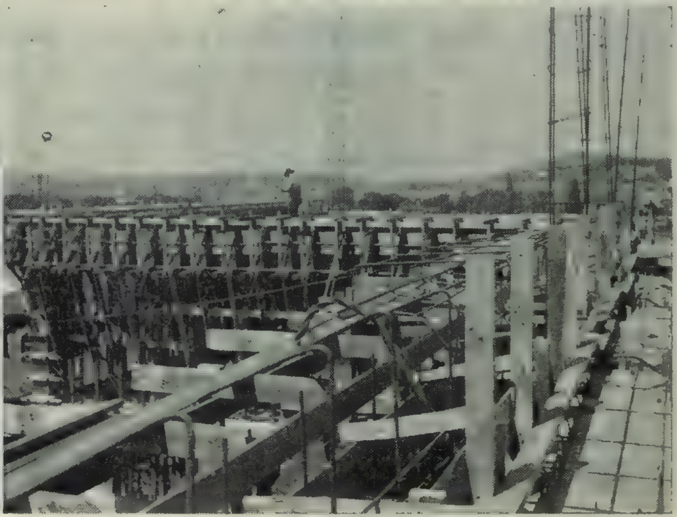
A feature of the work at this stage is the construction of the reinforced concrete cornice suggested by the contractors, Messrs. Parfitt Bros., as an alternative to the stone cornice specified by the architects, and the acceptance of which led to a saving of about $15,000 on this contract. A quantity of special form work and reinforcing had to be designed for this cornice, which is of considerable weight and has a projection of about three feet from the face of the building. Both forms and steel are shown in one of the photos reproduced herewith. The main reinforcement consists of verticals from the outside girder, bent over into the body of the cornice. Additional rods are inserted, bent around into the general profile of the cornice section, the ends being returned into the body of the girder, front and back. Additional security is given by the introduction of a one inch twisted bar brought up from the bottom of each cross beam, thus being spaced about 12 ft. apart. With a view to securing ample bond, these bars, the bent over end of which is visible in the photo, are extended for a distance of about ten feet along the bottom of the beam which forms their anchorage.

Western Wheeled Scraper Co's. Products

Mussens Limited, announce that they are putting in a stock of the Western Wheeled Scraper Company's goods in Toronto, for service to contractors, highway officials and others who may be interested. This company's products include wheel scrapers, drag scrapers, fresnoes, grading plows, rooters, ditchers, road maintainers and road graders. The "Western" line is well and favorably known all over the continent and recognized as standard among big contractors. By carrying a stock in Toronto, Mussens will be in a position to give quicker service. They are also carrying a partial stock in Vancouver and, as conditions improve in the middle West, are planning the same for Winnipeg.



General view of progress on the Jubilee hospital, Victoria, B.C.



Cornice forms and reinforcement for the Jubilee hospital

Construction Developments During the Month of June

Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded and Contemplated

Construction Contracts Awarded in Eastern Canada, June, 1922

	Ontario		Quebec		New Brunswick		Nova Scotia		Eastern Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	9	$ 87,500	2	$ 165,000	....	....	1	$ 5,000	12	$ 257,500
Churches	9	347,500	8	827,000	2	$ 82,500	1	40,000	20	1,247,000
Factories	10	376,500	6	4,153,000	1	75,000	1	125,000	18	4,729,500
Garages	18	209,200	38	78,800	....	....	1	10,000	57	298,000
Hospitals	1	225,000	3	1,586,000	....	....	1	30,000	5	1,841,000
Hotels and Clubs	7	203,500	1	6,000	....	....	....	....	8	209,500
Office Buildings	13	411,500	5	42,800	1	7,500	2	24,000	21	485,800
Public Buildings	7	192,600	1	5,000	....	....	1	5,000	9	202,600
Residences	1324	6,819,400	503	2,664,500	57	256,400	103	422,300	1993	10,192,100
Schools	26	995,600	18	835,800	3	233,100	4	161,500	51	2,226,000
Stores	83	1,149,500	38	483,200	6	23,500	9	52,000	136	1,708,200
Theatres	2	340,000	....	....	1	30,000	2	6,300	5	376,300
Warehouses	5	61,200	7	181,000	....	....	3	27,000	15	269,200
Total Buildings	1514	$11,419,000	630	$11,028,100	71	$ 658,000	129	$ 908,100	2350	$24,042,700
Bridges	23	$ 958,500	7	$ 93,500	4	$ 42,000	1	$ 1,400	35	$ 1,095,400
Dams and Wharves	2	64,700	2	45,000	1	150,000	....	....	5	259,700
Sewers & Watermains	13	419,000	3	17,200	1	5,700	....	....	17	441,900
Roads and Streets	31	1,664,900	11	822,000	2	151,900	4	115,000	48	2,753,800
General Engineering	14	1,458,000	2	65,000	....	....	2	80,000	18	1,603,000
Grand Total	1597	$15,984,100	655	$12,070,800	79	$1,007,600	136	$1,104,500	2473	$30,196,500

Construction Contracts Awarded in Western Canada, June, 1922

	British Columbia		Alberta		Saskatchewan		Manitoba		Western Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	....	....	....	....	....	....	1	$ 30,000	1	$ 30,000
Churches	....	....	4	$ 63,500	3	$ 44,700	..	....	7	108,200
Factories	1	3,500	2	28,300	1	20,000	2	133,000	6	184,800
Public Garages	1	12,000	2	13,000	2	8,000	3	37,000	8	70,000
Hospitals	....	....	1	16,100	....	....	....	....	1	16,100
Hotels and Clubs	2	36,000	1	5,000	2	10,000	1	1,800	6	52,800
Office Buildings	1	40,000	1	10,000	1	30,800	3	242,100	6	322,900
Public Buildings	2	21,300	....	....	....	....	4	30,000	6	51,300
Residences	179	689,600	168	551,000	124	417,200	242	848,500	713	2,506,300
Schools	4	27,200	6	61,700	11	202,900	4	121,400	25	413,200
Stores	14	210,200	7	36,300	13	99,300	14	64,300	48	410,100
Theatres	....	....	1	3,000	....	....	1	12,000	2	15,000
Warehouses	2	14,000	2	12,800	1	1,200	...	....	5	28,000
Total Buildings	206	$ 1,053,800	195	$ 800,700	158	$ 834,100	275	$1,520,100	834	$4,208,700
Bridges	....	....	....	....	1	$ 13,000	.	....	1	$ 13,000
Sewers & Watermains	....	....	...	....	.	....	2	$ 4,500	2	4,500
Roads and Streets	5	$ 383,300	2	$ 16,500	3	26,000	6	47,400	16	473,200
General Engineering	6	341,800	8	381,000	1	1,700			15	724,500
Grand Total	217	$1,778,900	205	$1,198,200	166	$ 874,800	283	$1,572,000	871	$5,423,900

Contemplated New Construction Work in Canada, June, 1922

	Ontario		Quebec		Maritime		Western		Dominion	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	4	$ 88,000	2	$ 28,000	—	....	—	....	6	$ 116,000
Churches	14	393,000	7	4,026,000	5	133,000	3	32,500	29	4,584,500
Factories	9	513,000	1	40,000		....	1	1,423,000	14	1,976,000
Garages	5	79,000	5	205,000	1	20,000	8	153,500	19	457,500
Hospitals	1	25,000	—	....	1	200,000	2	30,000	4	255,000
Hotels and Clubs	4	130,500	1	5,000	1	25,000	8	191,000	14	351,500
Office Buildings	8	1,097,000	1	30,000	1	15,000	4	96,500	14	1,238,500
Public Buildings	6	70,600	1	30,000	1	1,500	7	65,800	15	167,900
Residences	225	1,627,900	102	593,500	105	508,500	80	324,400	512	3,054,300
Schools	18	826,500	22	481,000	8	103,000	58	797,000	106	2,210,500
Stores	23	472,500	4	76,000	4	25,500	24	269,300	55	843,300
Theatres	2	115,000	1	360,000	2	24,000	1	12,000	6	511,000
Warehouses	6	163,000	1	60,000	1	200,000	4	93,000	12	516,000
Total Buildings	325	$5,601,000	148	$5,937,500	130	$1,255,500	203	$3,488,000	806	$16,282,000
Bridges	30	$ 415,500	12	$ 553,500	5	$ 114,000	12	$ 443,000	59	$1,526,000
Dams and Wharves	3	54,000	4	575,000	1	25,000	3	563,000	11	1,217,000
Sewers & Watermains	21	229,000	10	408,000		.	11	1,116,300	42	1,753,300
Roads and Streets	29	862,500	16	691,500	5	60,000	23	735,300	73	2,349,300
General Engineering	8	345,000	5	215,000	3	930,000	13	1,500,800	29	2,990,800
Grand Total	416	$7,507,000	195	$8,380,500	144	$2,384,500	265	$7,845,400	1020	$26,117,400

Unusual Forces in Designing Structures

A Discussion of the Forces Resulting From High Winds, Storm Waves, Ice Packs or Jams, Earthquakes and Geological Changes

By C. E. FOWLER
Consulting Engineer, New York

The engineer ordinarily designs his structures to resist the application of common and well known forces, such as the weight of the materials from which the structure is to be built; the live load it is to carry, consisting of people, vehicles or trains, temperature; and ordinary wind pressures. This is usually correct for the average structures, located in protected locations, or where they will not be subjected to extraordinary natural forces. These unusual forces may be covered by the general terms of high winds, storm waves, ice packs or jams, earthquakes, and geological changes.

The unusual or high winds are those of great velocity, beyond 80 miles per hour; the tornado; the monsoon; the typhoon; cyclone; and the hurricane. Storm waves are those produced in rivers, lakes, estuaries, and oceans by high winds up to 80 miles per hour and beyond. Ice packs or jams are produced by the pressure of great fields of ice, or the great jams formed by the breaking up of sheet ice and its piling up in channels or straits by currents, winds, and waves. The earthquake, while given a separate classification, is in reality one of the most destructive of geological forces, being caused by the sudden readjustment of the earth's crust. Geological forces as ordinarily classified are the scouring due to currents and waves, and the changes in cliffs and strata due to disintegration from various causes.

Wind Pressure

The usual wind pressure considered in designing ordinary structures is 30 lbs. per square foot, or that caused by a wind having a velocity 80 miles per hour or less. Winds having velocities of 50 miles per hour are considered hard storms, those of 55 to 75 miles very hard storms, and those beyond this as tornadoes, typhoons, cyclones, and hurricanes. Tornadoes are very severe inland storms; severe sea storms are termed cyclones or hurricanes in the Carribean Sea and Gulf of Mexico territories, cyclones or monsoons in the Indian Ocean, and cyclones or typhoons in the Western Pacific Ocean.

The formula long used in calculating wind pressure from the velocity is that of Smeaton propounded in 1759, $P=0.005\ V^2$, in which P is the pressure in pounds per square foot and V is the velocity in miles per hour. Due to the fact it gives somewhat higher values than modern more exact formulas, it is the proper one to use where the engineer prefers to provide for contingencies or to have results on the side of safety. The more exact formula of the United States Weather Bureau is $P=0.004\ (B/30)\ V^2$, in which P and V are as above, and B the barometer reading in inches; and becomes $P=0.004\ V^2$ for a barometric value of 30.0 in. Where the barometer reading was 28.15 in the hurricane of Sept. 1915, on the Gulf of Mexico, the formula would resolve into $P=0.00375\ V^2$, and with the maximum wind velocity of 140 miles per hour, would give a pressure of 74 lbs. per square ft. The Smeaton formula would give 98 lbs. per square foot for the same velocity, or provide to some extent for the probable impact of sudden gusts of such high velocity.

The pressure gages used for recording wind pressures at the Forth bridge in Scotland, gave a maximum of 41 lbs. per square foot, although 56 lbs. was the value used in designing, which was also the same as was used for the Firth of Tay bridge as redesigned and built after the blowing down of the original structure. The wind velocity or gust of 140 miles per hour at Burwood, La., in the September 1915 hurricane is probably as great as has occurred anywhere in the world. The steady blow did not exceed 128 miles per hour. The highest velocity recorded off the Pacific Northwest Coast is 90 miles per hour, and at Detroit, Mich., 87 miles per hour. The writer used a velocity of 125 miles per hour in calculating this eccentric pressure on the foundations for the Tacoma Smelter Chimney of about 600 ft. height, at Tacoma, Wash., to provide against sudden gusts, and about the same value was used for a large chimney in Montana. The conclusion most logical and undoubtedly safe is to assume a maximum velocity of 125 miles per hour for the most lofty structures or for very important structures, in the most exposed localities.

The following classification of winds is taken from the Beaufort Scale for Winds:

	Velocity Miles per hour
0 denotes calm	0
1 denotes light air	7
2 denotes light breeze	14
3 denotes gentle breeze	21
4 denotes moderate breeze	28
5 denotes fresh breeze	35
6 denotes strong breeze	42
7 denotes moderate gale	49
8 denotes fresh gale	56
9 denotes strong gale	63
10 denotes whole gale	70
11 denotes storm	77
12 denotes hurricane	84

The design of any structure to withstand such high wind pressures must be most seriously studied. The relative resistance offered by various shaped pieces used for structures, assuming a flat plate is 100, is for a square member 95 per cent; for a square member cornerwise .79; for a circular member .57; for a diamond with thin edge to wind .25; for a triangular member with face to wind .71, with apex to wind .42, and with the base parallel to wind .59; for a sphere .36; and a 60 degree cone 54 per cent. Where two circular plates of 2 in. diameter were separated 1.5 diameters apart the total pressure was only 75 per cent of that for one plate; while at 5 diameters it was 1.78 times the pressure on one plate.

The area presented to the wind by a riveted 300 ft. span truss bridge of usual design, would be about 22.7 sq. ft. per lineal foot of bridge, considering the pressure on the leeward truss as eight tenths that on the windward truss. However, by designing such a length span with circular top chords and posts, eye bar bottom chords, and lattice floor beams and stringers, the area per lineal foot of span would be cut to 10.7 sq. ft., or a reduction of over 50 per cent. This is near the theoretical extreme of possible results, but is an indication as to how thought can be profitably expended.

Wave Pressure

The pressure of waves may be due to waves of translation near a shore, or to oscillatory waves off shore where only one-half of the energy is transmitted forward with the wave form, and may effect such structures as light houses built some distance from shore, with a force as great as from 6,000 to 7,000 lbs. per square foot. The greatest force recorded by Stevenson was 6,083 lbs. near Tyree Island on the Scottish coast. The calculated effect of a wave 42 ft. high and 500 ft. long is 6,340 lbs. per square foot, but waves have been reported much in excess of this. The height of waves in the Mediterranean is from 15 to 20 ft.; in the Bay of Biscay 25 to 30 ft.; in the Pacific from 50 to 60 ft. maximum; and about the same in the Atlantic or up to 50 ft. in the North Atlantic in 1922; and earthquake waves up to 80 ft. in height, although some of this was most likely from the dash or break of the waves. Waves will dash up to a height of about 150 ft. on rocks or such structures as lighthouses.

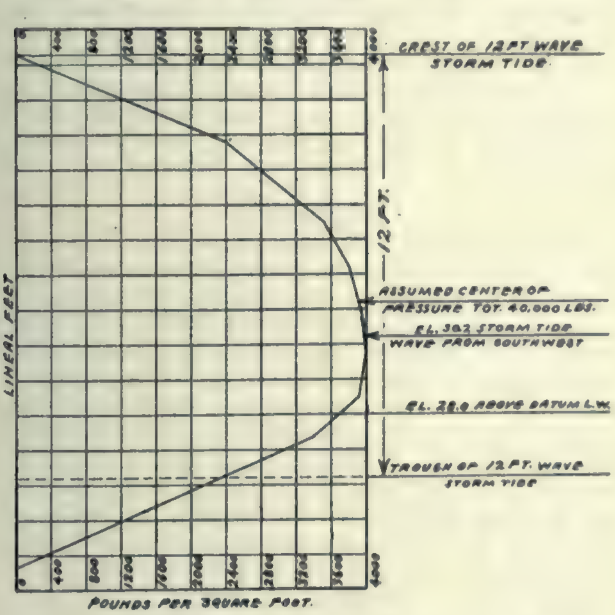


Fig. 1—Pressure record of waves at Negropoint breakwater

Waves of translation which affect harbor and shore structures were discovered by J. Scott Russel, the English authority, about 1835. When oscillatory waves reach shallow water they are transformed into waves of translation, where all the water particles move forward, and none backward.

The destruction at Corpus Christi in 1919 taught that the century-old belief that the hurricane waves spent their force on Mustang Island and the other low islands about 15 miles out was erroneous; and that with a storm tide of nearly 13 ft., carrying waves of translation on its crest, even for the short fetch of 15 or 16 miles across the very shallow bay, the waves reached a height of from 10 ft. to 12 ft. Such waves may strike a maximum blow of from 3,000 to 4,000 lb. per square foot. Their great velocity and destructiveness has caused writers to describe their combined action as a tidal wave. The writer doubts if a true or real tidal wave has ever occured during any of the Gulf hurricanes. The fact can be positively stated that such low barrier islands and shallow waters as occur off Corpus Christi and other Gulf localities are not a protection that can be depended upon.

The waves off the open shore at Peterhead in North Britain are also evidently transformed into waves of translation, as on Feb. 15 and 16, 1900, with a wind of from 50 to 89 miles per hour and in water only from 60 to 65 ft. deep, the waves rose to a height of 22.5 ft. above still water level, or a total water height of over 30 ft., possibly over 40 ft.

The writer, on Dec. 14, 1920, was crossing the Detroit River by ferry at 10 o'clock a. m., and found a very high wind blowing directly up the river at the time, and very high waves running in about 40 ft of water and with a fetch of only between 2 and 3 miles. The velocity of the wind was found by a visit to the Weather Bureau afterwards, to have been 54 miles per hour, and waves were observed on the sides of a scow being towed in midstream, of from 6 ft. in height to over 7 ft. Upon my return at 12:00 noon the wind velocity had increased to 60 miles per hour, and waves were observed from 7 ft. to 8 ft. high, which height was verified by an engineer associate along with me. It is interesting to note that the writer weighing 200 lbs. could just walk against the 60 mile wind, and that he saw a lady blown off her feet.

The account of the Sept. 29, 1915, hurricane speaks of swells of from 10 to 12 ft. running on the Mississippi River. Russell records that he never saw waves 10 ft. high in 10 ft. of water, nor 20 ft. high in 20 ft. of water, although he had seen waves approach very nearly to those limits.

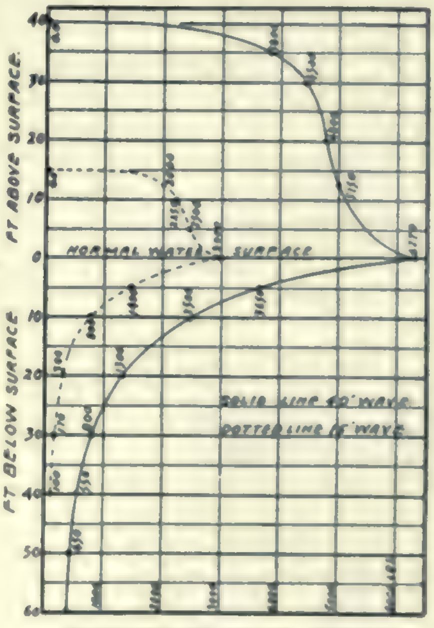


Fig. 2—Distribution of pressure of dashing waves

The observations of many observers as recorded by Johnson lead him to say that when waves run into shallow water they seem to awaken into new life, crowding closer together and increasing in height until they break; likewise waves running against a current increase in height. Such waves of translation transmit forward their full energy, while as stated only one-half of the energy is so transmitted by oscillatory waves.

Height of Tides

The highest recorded storm tide on the Gulf Coast was of 16 ft. in 1919 near Corpus Christi; one of 9.8 ft. in Lake Borgne near the Rigolets or the entrance to Lake Pontchartrain, and one of 13 ft. near Frenier at the western end of Pontchartrain. The amount of water that passed in and out of Pontchartrain, must have amounted to nearly 90 billion cubic feet. The great maximum velocity of this is evidenced by the way in which it tears out great areas of the marshes. The height to which structures must be raised to clear such maximum storm tides as 16 ft., carrying wave crests 9 ft. above such level, is thus clearly shown, and if such a clearance is impossible, then as stated, the design of structures must be such as to largely nullify the wave force.

The force of waves of translation may be expended against sea walls, breakwaters, or piers in two ways, by the resultant direct pressure against a flat surface; or partly by direct pressure and partly by the impact from the splash of the wave. The diagram Fig. 1 shows the wave force obtained by dynomometer readings at Negropoint breakwater, St. John, Canada. The maximum observed pressure was 4,000 lbs. per square foot, with the storm tide at the level of the dynomometer. The computed height of the wave was 12 ft., the assumed centre of pressure was 1 ft. above L.W. storm tide or 3.2 ft. above H.W. O.S.T., and the assumed pressure of the storm wave per lineal foot of the wall 40,000 lbs.

The force of a dashing wave is given by Prof. Luiggi, the eminent Italian authority, in the following data as derived from observations. These were made on waves from 19.5 to 22.75 ft. in height and dashing in jets up to 65 ft. high.

Below sea level	32.25 ft.=	450 lbs.
Below sea level	19.5 ft.=	1,345 lbs.
Below sea level	13.0 ft.=	2,020 lbs.
Sea level	0.0 ft.=	6,300 lbs.
Above sea level	13.0 ft.=	4,950 lbs.
Above sea level	32.25 ft.=	4,250 lbs.

This type of wave force is shown graphically in Fig. 2 by the solid line, or for a 40 ft. dashing wave, while the dotted line gives values for a 15 ft. dashing wave as plotted by comparison.

The height of waves may be computed from the formula: Height=1.5 x square root of F+ (2.5—fourth root of F) in which F is the fetch for short distance wind action in natural miles.

This formula is shown graphically in Fig. 3, but under actual conditions that may exist, the values shown may be exceeded by from 25 to 50 per cent. The actual values for any given locality may have been recorded, or it may be possible to make records previous to the designing of the structure; but if the calculated value must be used, then the structure must have a factor of safety great enough to provide for a force at least 50 per cent greater than the calculated one.

The form of the structure is mose important in that it must offer the least possible resistance to the waves. The Galveston sea wall is an example of this, but in making a curved face there must be a serious reverse curve at the top, so that the water will not dash up vertically and cause damage by the drop of the tons of water falling. Likewise there must be no joints or horizontal offsets or the lifting force of the wave must be accounted for in designing. The design of bridge piers to resist waves must be such as to offer small resistance, and while a cut-water formed by arcs of circles on an equilateral triangle is good, a pier of elliptical cross-section is better. Sea walls may be so designed as to cause the water from a wave to fall back practically dead, and protective devices may be used for the protection of bridge piers and other structures.

Ice Pressure

The pressure of ice jams in rivers, straits, estuaries, or often the pressure of ice packs must be taken account of in designing engineering structures. The pressure of moving ice in rivers where ice is likely or sure to run, may be ordinarily taken at 300 lbs. per square inch, but on the St. Louis bridge it was figured at 600 lbs. per square inch on the area estimated to be covered by the crushing ice. The ice may jam down to the bed of the river, so that the resultant pressure from ice jams or even log jams will probably be that due to the hydrostatic pressure on a bridge pier and half spans on either side, from the hydrostatic head due to the difference in the elevation of the water above and below the bridge.

The specifications for highway bridges of the Ohio Highway Department, considers "the force of floating ice upon structures subject to it, shall be taken as 30 tons per foot of width exposed, as measured at right angles to the direction of flow. It shall be taken as acting at an elevation above low water stage equal to at least two-thirds of the difference between high and low water." Where the ice conditions are very severe, it is more than likely that it will be difficult to arrive at any exact basis for calculations, and the judgement of the engineer must govern. However, it is unlikely that in any case it will be necessary to exceed the provisions of the piers constructed for the Victoria bridge at Montreal, by Robert Stephenson, which have withstood the most severe ice pressures of over 60 years. The safe method is to consider the pressure as acting at the level of high water, as ice usually goes out on a big rise in the river.

The pressure from ice packs or great crowding

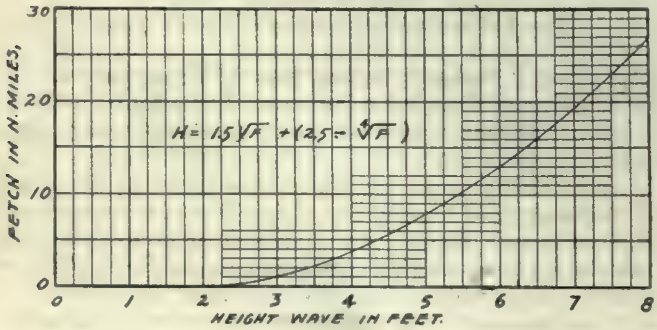


Fig. 3—Height of waves for short fetch

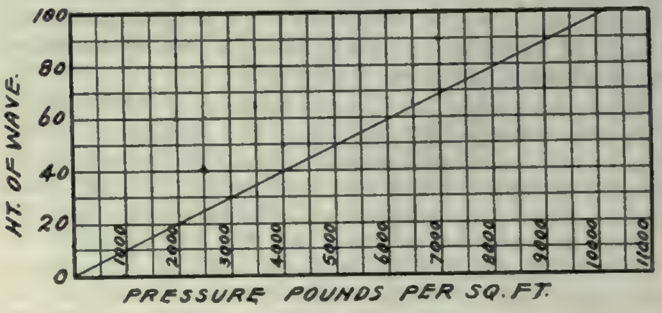


Fig. 4—Pressure of waves

fields of ice has never been recorded, but from moving pictures showing ships being forced vertically upwards by the wedging action on the bottom slope or dead rise of a vessel, it is fair to assume the pressure to be much greater than for an ice jam. Assuming the force of the couple gripping the ship to be that from a vise-like action over a height of 20 ft. of the sides of the ship, we must conclude that the force may reach double that previously stated of 1,200 lb. per square inch. Such action may occur in the case of bridge piers for bridges across lakes or bays, or similar isolated structures, but not in the case of sea walls or breakwaters.

Earthquakes

The destructive force from earthquakes may be that from the quake itself, or from a resultant tidal wave on an adjacent ocean in which case the preceding discussion as to wave force would apply. The earthquake consists of a wave action of the earth's crust accompanied by more or less of a twisting motion. The force of such twisting or torsion is small and may be disregarded in a well designed structure. The wave being of great length, its vertical action is comparatively small as well, but is destructive enough to break lines of water pipe, tunnels, or other structures crossing fault lines. Where it is absolutely necessary to cross a fault, then the structure must be so designed as to either make breakage unlikely, and in event of a break, easy to repair, temporarily at least.

The most destructive feature of earthquakes is the horizontal motion or rapid oscillation, and anyone who has been through one knows the "feel" of this, and the effect from hearing window heights hammer back and forth. The resultant effect on a structure is similar to that from wind, and it is possible that any structure designed for a full wind load will withstand quite severe earthquake shocks. However, the stresses are very much greater than form a force acting in one direction, due to the very quick reversal. The structure should be made of highly elastic material and design; and as light as possible, especially in the upper portions, and no heavy or concentrated weights should be placed aloft. Heavy concentrated foundations are best, and the structure must be fairly and completely anchored to them in an elastic manner.

The examination of a 1,500-ft. suspension bridge with towers about 300 ft. high, showed that the increase of stresses from a heavy shock would not be dangerous in any respect, but that the details of construction required special design throughout. This was on the basis of a shock having an amplitude of 2 in., giving a maximum acceleration of 10 in. per second, and a lateral force equal to 2.59 per cent of the weight of the structure. The horizontal shear at the base of the tower was found to be less than half that due to wind load and the uplift on the windward side only about 11 per cent of the dead load reaction.

Geological Forces

The natural changes of a foundation bed for piers in a river due to the scouring out of the bottom may prove to be a very dangerous matter, and can only be foreseen by a careful study of records if they exist, or by a series of borings at intervals so that the geological cross section can be completed and the lowest stable stratum determined. Should the bed of the stream scour deeply, much of the allowance that might have been made from skin friction on the pier would be nullified, water might get under the bottom of the pier and cause a dangerous uplift, especially when combined with the greater overturning forces that would act on the pier in the deeper water. The filling in of dredged channels or harbor basins, due to the solid material carried into them by rivers may easily result in their ruination practically or in a financial way. Rivers that are used as ship channels may fill up so rapidly as to make the cost of continual dredging prohibitive.

The currents induced by winds and waves in the mouths of rivers or estuaries may become of very serious concern, in causing the scouring out of foundations for piers, seawalls, or other structures.

The currents in estuaries during a hurricane have, so far as known to the writer, never been measured, but it is fair to assume that at least the surface current as partly generated by the wind and waves of translation, when added to the usual currents, will have an exceedingly high velocity. While the ordinary tidal currents in channels at various points along the Gulf Coast may have only a maximum value of from 4 to 8 miles per hour near the surface, it is quite certain that the combined surface velocity may reach as high as 12 to 15 miles per hour during a wind of a velocity exceeding 100 miles per hour. The serious disturbance from waves reach to depths of water of 60 ft. or greater, and the combined current as above will have a velocity at similar depths that will cause serious scouring effects in channels having ordinary materials for the stream bed. Thus by observations as to the class of material scoured out, we can easily fix the velocity at the bottom of any channel, and it will in the writer's opinion, seldom be found less than 4 miles per hour in ordinary channels from 50 to 60 ft. deep. This would cause scouring in sand and even fairly heavy gravel. The reduction of ordinary current velocity from near the surface to the bottom of the river, has roughly the curve of a convex ellipse, but the reduction of velocity from the surface to the bottom, in a tidal channel during a hurricane, would undoubtedly approach nearly to the curve of a concave parabola, due to the banking up of the swiftly moving water against the slower moving or comparatively slack water of the ordinary flow.

Changes in Shorelines

The changes in shorelines, beaches, cliffs, headlands, and the like by ocean waves are of too intricate a nature to discuss in a few paragraphs, but the engineer having to do with ocean or harbor structures should read "Shore Processes and Shoreline Development" by D. W. Johnson from cover to cover. The suddenness with which such changes may come about is illustrated in a statement by Kinahan, that at one point on the Irish coast a beach 600 ft. wide was created during the spring of 1876, in front of a cliff on the coast, where there was deep water the preceding winter. Austen says in regard to the southern coast of England that "during the first few hours of a gale, enough material may be removed from the shore face to deepen the water there from 5 to 10 ft., especially where a sea wall helps to concentrate the wave energy along a narrow zone." Along the Chesil Rank a single storm has removed 3,763,300 tons of shingles from the beach.

"In the preceding paragraphs I (Johnson) have endeavored to give the reader some idea of the serious difficulties which confront the student of shore processes. It must be confessed, however, that it is much easier to describe the complexities of currents and to point out the mistakes which are frequently made in interpreting them, than it is to solve those complexities in a given case and present a discussion which is so conclusive as not to be open to criticism. Nevertheless, it was essential that we should enter upon our treatment of shoreline forms with a broad view of the problems connected with wave and current action, and with some appreciation of the variety of the forces which operate at the shore in different places and at different times. We are now prepared to consider the development of shore lines more intelligently, even if we are not prepared to assert with positiveness the precise part played by different currents in shaping each portion of any given shore.

"The time will come when our present limited knowledge of both wave and current action will be enormously extended by means of improved mechanical appliances. The movement of debris upon the bottom at considerable depths during wave action, concerning which we can only theorize at present, will be actually observed by special electrical apparatus. Wave currents and currents of other types will be studied by observing the exact movements of debris under their control. Limited areas of the coastal waters will be exhaustively studied, every detail of the currents analyzed with care under varying conditions, and the movements of debris determined with far greater precision than is now possible. While shoreline problems will never be simple, the researches of the future will yield a body of facts which will enable the geologist and engineer of some coming generation to predict shore changes and plan harbor and coast defenses with an assurance which will contradict the assertion of the present maritime engineer, that the forces operating at the shore are among the forces of nature, "which are subject to no calculation."' In the meantime we may take some satisfaction from the fact, which will presently appear, that a great deal may be learned about current action by studying the forms of beaches, since these often provide a more reliable indication of the dominant currents in a given locality than do any direct observations feasible at the present time." (Johnson.)

The danger from high overhanging cliffs is well illustrated at Niagara Gore. Below the Whirlpool the overhanging has largely broken off and fallen to the bottom, so that the tens of thousands of tons of huge boulders have acted in the nature of a gigantic rip-rapping, and the high banks have thus reached an angle of repose. The cliffs above the Whirlpool on the other hand have had more human interference and protection, so that the huge boulders are largely absent, and the river channel is scouring wider and deeper. The dangerous overhang has been and is being continually removed as a protection to the Gorge Railway; and similar removal was done at the Railway Arch Bridge by the writer in 1919, in response to warnings of some slight falls, which should they have been large in extent might have endangered the structure. Some large falls on the Gorge Railway have stopped traffic for from one to two weeks.

The complex series of spits and bars composing Nantasket Beach on the Massachusetts coast, show that "the phenomenon of a shifting fulcrum between a retrograding cliff and a prograding beach plain may occupy an important place in the history of a shore line."

"Continued wave erosion soon pushes the notch so far into the land that the unsupported overhanging rock falls down under the influence of the forces of weathering, including the action of gravity and rain wash on the face of the slope. This produces the wave-cut cliff, in front of which is the wave-cut rock terrace called the bench. The eroded debris will be added to the submarine talus if the shoreface slope is steep enough and the water deep enough, except such part as is ground sufficiently fine to be widely distributed over the sea-bottom far offshore. If the water is shallow or the slope gentle, a shoreface terrace may be formed at this time."—(Johnson.)

Conclusions

The engineer in dealing with any of the problems of design arising from the necessity of having to build a structure subject to such unusual engineering forces, has two sources open to him. First, to design the structure along usual lines, of sufficient strength to withstand the maximum probable or known unusual forces; or second, to so design the structure that it will offer less surface to the unusual forces, or else a minimum chance of having to resist such forces.

Where it is possible to follow the second method and make the structure of special design, but along proper theoretical and practical lines so that it will minimize the effect of the forces, this is without any question the method to pursue, both from motives of good engineering and economy. However, when the engineer after the most careful study has exhausted all possible hopes for such a special design, then the only thing is to design the structure along usual engineering lines, but of sufficient strength to withstand all the maximum forces, and to some extent regardless of cost.

Should the maximum forces of every kind be absolutely known, then it will be permissible to allow unit stresses for a maximum possible combination of all forces, that are only safely within the elastic limit of the material; or where the forces of stability are in excess of those of destruction. Each case must most emphatically be made a special problem, and all that has or might be written should be no more than a guide to its solution—"Engineering and Contracting."

C. P. R. Pier at Vancouver

The Canadian Pacific Railway Company is calling for tenders for the superstructure of the new pier which the company is constructing at Vancouver for the accommodation of its ocean liners. The foundation fill for the pier is already in place. The new work will give employment to several hundred men for approximately 12 months. This is the largest work undertaken in several years in Vancouver by the Canadian Pacific Railway. The pier will be 850 feet long and 330 feet wide, and its estimated cost is about $2,000,000. It is proposed to have it completed by September 30, 1923. Tenders are to be in by July 17.

Rule of the Road in New Brunswick

The provincial government of New Brunswick passed an order-in-council on July 5 authorizing the issuing of a proclamation which will make "keep to the right" the rule of the road in the province on and after December 1st next.

The Efficiency of Irrigation

Water Losses and Ways of Reducing Them —Distribution—Duty of Water

By G. E. P. SMITH

In Bulletin of the University of Arizona

In these days we hear much about efficiency. There is such a thing as efficiency of irrigation. It may be defined as the ratio of the water beneficially used to the total water diverted onto the land. The water beneficially used is the water that is actually drawn upward by plants (not including weeds) and is transpired through the stomatal openings into the atmosphere. The transpiration of plants is far greater than most of us imagine. The U. S. Department of Agriculture tells us that alfalfa transpires about 1,000 lb. of water for each pound of hay produced. It is the water gourmand, other crops requiring less. The losses of water are by evaporation from the soil direct, by seepage downward beyond the reach of plant roots and wilful or careless waste, which includes irrigating the county highway. These losses aggregate from 10 to 80 per cent. of the water applied, depending on the method of irrigation and how well the irrigation is performed.

Water Losses from Canals and Ditches

Another loss of irrigation water is by seepage and evaporation from canals and ditches; this, the greatest loss of all, should not pass without comment. Nearly all of this loss is by seepage. Measurements of the seepage losses on scores of canals and ditches have been compiled and published. The results are startling. Losses of over 10 per cent. of the water per mile of ditch are not infrequent, and it is concluded that "a large percentage of the water, estimated at 40 per cent. of the amount taken in at the heads of the main canals, is lost by absorption and percolation along the routes." The records of the U. S. Reclamation Service in the Salt River Valley state that the canal losses between the diversion dams and the points where water is delivered to the water users have been from 40 to 45 per cent. of the total amount diverted. While the losses as given in the records may be overstated somewhat, it is certain that at least one-third of the water diverted is lost in the canals. The loss from the Avondale Canal is 40 per cent. in the first four miles.

No practical method of preventing canal losses has been found except by the use of concrete linings for large canals and cement pipe for small canals and for farm ditches. Linings and cement pipe lines have been highly developed as to permanency and efficiency, and the cost is so low as compared to the value of the water saved that it is only good business economy to make the investment. Linings and pipe lines have many additional advantages. They may obviate the need of an expensive drainage system to prevent water-logging; ditch cleaning is eliminated; breaks, especially those caused by gopher holes and the tramping of stock, cannot occur; the labor cost of irrigating is greatly reduced; and pipe lines permit of running the lines through low ground instead of following contours around the low places.

Ways of Reducing Evaporation Loss

For the losses which occur in the transportation of water, irrigation associations and the land owners must divide responsibility, but for the losses which occur after the application of the water to the land, the farmers are responsible individually.

There are many ways by which the evaporation loss can be reduced. Some of them are deep plowing, frequent cultivation, use of fertilizers, reducing the frequency of irrigations, and irrigating at the right time. Windbreaks also tend to reduce the evaporation. The land should be thoroughly irrigated before planting; "irrigating the seed up" is an unfortunate practice. Where the soil is deep and retentive, one thorough irrigation of alfalfa per cutting is better than two; it should be applied about eight or ten days before cutting and not just after cutting. On light soils two and sometimes three irrigations per cutting are required; the irrigation should be light. If two irrigations are given, one should be given when the alfalfa is about 5 in. high and the other about five days before cutting. It is assumed that at those times the color of the alfalfa will be darkening noticeably, but that the leaves have not begun to show wilting.

Loss of Water by Seepage

The loss of water by seepage is the hardest one with which to deal. The extent of this loss is not apparent from surface inspection, and the remedies are not obvious. To prove that the loss exists and is large is not difficult. Nearly all irrigation projects soon encounter difficulties due to the rise of the water table, causing or threatening alkali troubles and water-logging.

On most soils it is inevitable that there should be some seepage downward and in districts where the irrigation water contains considerable alkali or the soils are naturally alkaline, a moderate degree of downward percolation is desirable in that it prevents accumulation of the alkali in the surface soil, but ordinarily the seepage loss is excessive and is unjustified from any standpoint. The seepage may be due to general over-irrigation, too heavy and too frequent applications of water. More often, I believe, it is due to the unequal distribution of water over a field. While the irrigator endeavors to get sufficient water to one part of the field, another part receives such an excess that a large portion of it seeps downward beyond reach of the root system. On lands that take water readily, many cases have been observed where the head ends of the land receive water for from one to three hours, while the tail ends receive only a dribble, and that for only a few minutes. Surely, this is not an ideal irrigation.

Uniformity of Distribution of Irrigation Water

Several years ago, the writer made some investigations to determine the uniformity of distribution of the irrigation water. In one case, on heavy loam, it was found that the average percentage of soil moisture at the head of a land, for six feet depth, was increased from 24.1 to 26.3 per cent. by a 4-in. average irrigation, while at the tail end the soil moisture was increased from 15.4 to 18.2 per cent. In another case on sandy loam the soil moisture at the head end was increased from 14.3 to 21.1 per cent. and at the tail end from 8.3 to 12.2 per cent. In both cases, therefore, the head end had more soil moisture before irrigating than the tail end had after irrigating—a preposterous condition. Inasmuch as the alfalfa near the foot of each land was making excellent growth, it follows that the head ends of the land were getting unnecessarily large, wasteful amounts of water. On one of the fields thus tested the average depth of water applied in 1914 was 108.2-in. Unquestionably, 50 per cent. of the water thus applied sank to the water table and was wasted. Many similar cases have been observed where the quantity of water absorbed at the head ends was found to be excessive and wasteful. When these conditions exist, the remedy is less water more rapidly applied, by means of a larger head, or shorter runs, or steeper slopes.

Slope of Land and Head of Water

The problems of what slope to give the lands and what head of water is best are inter-related, and involve also a discussion of the length and width of lands, and the character of the soil. Any one of these five factors can be taken as a function of the other four factors. The problem is complex and should be solved separately for each crop, and for each locality.

In some communities, the solution is thought to be the grading of the lands level, or on a very slight gradient, which entails an additional expense of $20.00 to $40.00 per acre. This outlay is of doubtful utility. In the writer's opinion the lands should be graded down the natural slope or approximately so. Surely any lands with slope from 3 to 40 ft. per mile and with good soil can be laid out and irrigated without material change in the general direction of the slope.

The other factors, then, can be determined so as to give the most uniform distribution of water. Thus, on light soil with a grade of 20 ft. per mile, where a large head of water is available, perhaps the lands can be laid out 50 ft. wide and 880 ft. long. If the head of water is small, as from a No. 5 centrifugal pump, then the lands should be not over 30 ft. wide and 440 ft. long. If, however, the grade is only 10 ft. per mile, the lands, perhaps, should be 660 ft. long for the large head and 330 ft. long for the small head.

These values are intended to be suggestive; on shallow soils underlain by caliche the lands can be longer; in some cases lands 1,300 ft. long are irrigated successfully. For heavy loams the lands can be considerably longer than for sandy soil, and in general the flatter the grade, the shorter should be the runs and the larger should be the head of water. Heavy, or "hard," soils are found usually on flat slopes, as from 5 to 10 ft. per mile. In the latter case, the lands may be as long as ¼ mile, but they should be narrow, say 36 ft. wide, so that a small unit head can be made to cover the width uniformly.

Uniformity of Distribution

The final adjustment to obtain an even distribution should be made by varying the head of water in each land. This adjustment should be made last because it is the easiest to make. Recently an irrigator near Mesa, Ariz., complained that the stand of alfalfa was better in the lower part of his field than in the upper part. He wished to regrade the field so as to reduce the fall. But the remedy was much simpler than that. His head of water delivered by the Reclamation Service was 300 miner's inches. By changing his order and obtaining 275 miner's inches he would get a uniform irrigation and uniform crop. Many irrigators have difficulty in getting the water across their land. They require a large unit head. They should order more water, or concentrate it in fewer lands, or if this cannot be done without increasing the unit head to a point where it will erode the soil, then the length of run should be reduced.

Uniformity of distribution is possible, but requires thought and skill and probably some investigation on the part of the irrigator. Every irrigator should use a soil auger or a shovel to ascertain the penetration of the water and the condition of the soil, at least to 5 ft. depth, before and after an irrigation. This should be done near the head end, near the center, and near the lower end of one or of several lands. It would be folly to lay down general rules for the lengths of lands, the slope, the desirable heads of water, or the frequency of irrigations. Much good sense and judgment must be exercised. Even variations of climate may vitiate a rule.

Duty of Water

As to the total quantity of water required for a crop in a season, little will be said here. The amount of water applied per acre is called the duty of water, and is best expressed by stating the number of acre-feet of water per acre per year. In many localities, however, the duty is stated as the number of acres per miner's inch or per second-foot, or the number of miner's inches per quarter section of land.

Alfalfa requires more water than any other common crop, and alfalfa is the best basis for study and for comparison between different practices inasmuch as it is grown extensively on all varieties of soil and in all altitudes and climates.

The most elaborate duty of water investigations have been made in Idaho and California. In Idaho, Don H. Bark, after investigations covering four seasons and costing $60,000, published many definite conclusions, one of the most interesting of which is that the economic irrigation of alfalfa, in Idaho, on good loam soil, in an irrigation season of a hundred days requires three acre-feet of water per acre. The investigations of the California Agricultural Experiment Station have concluded that, in the Sacramento Valley, alfalfa should receive from 30 to 36 in. depth of irrigation, the first cutting and sometimes the first two cuttings being obtained before any water is applied. In Arizona the irrigation season is over 200 days in length, and investigations show that there is about as much increase in crop in the application of the seventh or eighth acre-foot per acre as in the third or fourth, and the rate of increase is a little over a ton of hay per acre-foot applied. One record in the Casa Grande Valley in 1918 showed 22 irrigations of about 5½ in. depth each. The owner claimed that he cut 13 tons per acre, and the county agricultural agent maintained that the record was correct. There seems to be almost no limit to the amount that can be beneficially applied to alfalfa, but excessive amounts cannot be recommended or tolerated because of the rising ground-water plane that inevitably results.

With other field crops, however, there is an optimum amount that should be applied, and if a larger amount is used, the crop yield is actually reduced. Cotton requires from two acre-feet on medium loam soil to three acre-feet on light sandy soil and on new desert soil, and milo maize requires even less. Rice, in the Sacramento Valley, requires from four to five acre-feet per acre.

In comparing records of the water used in different localities, it is found that the duty of water is much higher when the water is delivered and charged for on a measurement basis than when the irrigator pays a fixed price per acre per season. In places where the basis of payment for water has been changed from the flat rate to a definite sum per acre-foot, the quantity of water used by farmers has decreased at once. Rotation of water, also, results in a marked saving over the older practice of continuous flow to each water-user, a practice that still obtains in the more northerly irrigated states.

Not the least important among the factors determining the acreage that can be served by limited water supplies are the character of state laws and the attitude of judges and others charged with the disposition of existing water rights and of new appropriations of water. California and Montana are unfortunate in this respect. In California there has been much confusion in laws and court decisions. Montana has no adequate water code; ditch owners help themselves from the common source of supply, often to the detriment of prior appropriations, and the tendency is to apply water wastefully to the land in order to hold claims to excessive amounts. Many court decisions in other states have decreed wasteful amounts to water users, thus preventing development of more land.

Sewage Disposal by Dilution

A Review of a Process that Has Been Going on in Nature for Centuries

In the April edition of the journal of the Institution of Sanitary Engineers there is an excellent article by Mr. G. Bertram Kershaw, M.Inst.C.E., on "Some Notes upon Sewage Disposal by Dilution," in which he begins by stating that there is nothing new in the proposal, and that the method has been going on in Nature for centuries, but that for one reason or another it is regarded rather askance by some people as being an "evasion of certain customary duties." He attributes this in some measure to the dictum of the Rivers Pollution Commission of 1868, which was: "There is no river in the United Kingdom long enough to secure oxidation and destruction of any sewage which may be discharged into it, even at its source." This sweeping statement, however, cannot have been correct, as, if our recollection is not a fault, the town of Tiverton discharged all its sewage from a population of about 10,000 into the river Exe, only about 10 miles above Exeter, up to the end of 1890, and the inhabitants of that city drank the waters of the Exe with impunity. Chemical analysis of the water at various points showed at the time that purification by dilution was acting actively.

Mr. Kershaw then quotes Mr. Pembroke Stephens, Q.C., in 1885, when he said, "You have now reached the limit at which sewage may be turned into that stream," and pointed out that in future they must ascertain the volume of the river, the density of population, and "establish your just proportion" and then "call on your town to cease to pour in offensive matter."

Mr. Kershaw then notes from the Sewage Commission's eighth report of 1885, to the effect that there are circumstances in which sewage, either partially treated or not treated at all, might properly be discharged into rivers or streams. He goes on to say: "It is fairly obvious that a stream having a flow of, say 1,000,000 gallons per 24 hours, could receive 1 gallon of sewage daily, spread over the 24 hours, without any perceptible alteration for the worse in the character of the water, so far as the ordinary amenities of that stream were concerned. It is also manifest that if the same stream flow received 1,000,000 gallons of sewage per 24 hours it would soon be in a filthy state. It follows, therefore, that there must be some critical point between the dilution of one in a million and one in one beyond which it would be unwise to burden the stream, if it is not to be detrimentally affected." He then refers to the riverside observations which the Sewage Commission carried out in 1898 with a view to ascertaining this critical dilution—whether it would be possible, where the respective volumes of sewage and river were known, to predict the effect of the discharge upon the water in the river, "together with the analytical figures for both sewage liquor and river water . . . and also to find out whether the chemical interpretations drawn from the figures of analysis obtained in the laboratory ran parallel with the actual results observed in Nature." Mr. Kershaw, when engineer to the Commission, visited some fifty rivers in all parts of the country, and the results of his observations on these rivers are given in the appendix to the eighth report of the Commission.

He then proceeds to state that "Clean river water at a temperature of 60 deg. F. and normal pressure contains about 6 c.c. of dissolved oxygen per litre, equivalent to 1 part by weight per 100,000. Other things equal, the colder the water the more oxygen will it hold in solution, the figure at 0 deg. C. (32 deg. F.) being 10.2 c.c. per litre, while at 20 deg. C. (68 deg. F.) it holds 6.4 c.c. per litre. The oxygen is absorbed from the atmosphere, and, in the absence of further pollution, so long as a river water receiving a polluting liquor which takes up dissolved oxygen from the water can reoxygenate itself from the atmosphere at a rate sufficient to balance the deficit brought about by the pollution, no offensive conditions can arise. The agents of purification—e.g., low organisms and bacteria—require and use up oxygen in their life processes, and if the water becomes denuded of oxygen by their action, purification ceases, the organisms of purification die, and objectionable conditions arise, with only such forms of life remaining as are capable of existing with little or no oxygen."

He then refers to the rate of reaeration of fresh water which is dependent upon temperature, wind, evaporation, etc., and that "the rate of reaeration of water increases with the degree of deoxygenation—i.e., a water containing, say, 1 c.c. of dissolved oxygen reaerates more rapidly at first than one containing 4 c.c. As the oxygen content of the water approaches saturation, so the rate of reaeration decreases. The rate of reaeration, too—given uniform density of water—decreases as the depth of the water increases—that is to say, it diminishes from the surface of the water downwards." Mr. Kershaw then gives an extract from the eighth report of the Sewage Commission, 1898, showing how largely the fauna and flora of river waters are affected by seasonal changes, and, after giving a table of these changes for the twelve months of a year, he proceeds as follows:—

"It will be seen that during the warmer months of the year the bacterial content of the sewage increases greatly. For example, the total on plain agar rises from 380,000 per c.c. in January to 4,100,000 per c.c. in September, or an elevenfold increase, and this seasonal increase applies broadly to all organized life. It is now well enough known that purification in rivers and streams is brought about by the agency of bacteria, in the presence of air, and that these minute organisms require a considerable amount of oxygen for their life processes. The writer has always maintained that too little attention has so far been directed to the higher forms of life, and to the part they perform—both animal and vegetable—in bringing about purification, bacteria hitherto having had most of the limelight. Probably, as time goes on, the more highly-organised forms of life will be studied, and they will receive due recognition for the work they carry out, both in actual purification and also in bringing polluting matters into forms assimilable by lower organisms. It may be instructive, before proceeding further, to mention some of the higher forms of life which are distinctly helpful in the purification of rivers and streams. It is impossible to do more than refer very briefly to the enormous and widely-varying hosts of invertebrate animal life found in rivers, inland waters and oceans, which carries out its duties in assisting in the destruction or purification of organic matter. The life histories of any of them are unknown to the student of invertebrate zoology. The two great divisions are the Protozoa, or unicellular animals, the bodies consisting of a single cell usually of microscopic size, and the Metazoa, or multi-cellular forms, their bodies consisting of a number—usually an immense number—of multi-cellular forms, differing in form and function. All the Metazoa, however, begin life as a single cell, from which the aggregation of cells and tissues forming the organism is built up," and he proceeds to give a detailed and learned description of some of this animal life inhabiting our rivers. He finishes this portion of his article by stating that, quite apart from bacteria, there are numerous higher forms of organism which are most helpful in the matter of purification of sewage by dilution. In addition, he says there are the various algae and the numerous species of aquatic plants, many of which "are most useful, not only in sheltering minute forms of life but in giving off oxygen."

Depth of stream (feet).	Mixing period (hours).	Residual D.O. to be (c.c.).	Aëration (per cent Sat. per hour).	Dilution for				
				Sewage		Liquors.		Effluent.
				Strong. (1).	Average (13/20).	Tank. (10/20).	Pptn. (5/20).	(0·5/20).
5	1	6	·08	1,100	715	550	275	28
—	—	4	·33	267	173	134	67	7
			—	(250)	(160)	(125)	(60)	(6)
—	6	6	·04	2,200	1,430	1,100	550	55
—	—	4	·15	590	385	295	148	15
10	1	6	·03	2,900	1,890	1,450	725	72
—	—	4	·12	730	475	365	182	18
			—	(700)	(450)	(340)	(170)	(17)
—	6	6	·02	4,400	2,860	2,200	1,100	110
—	—	4	·07	1,250	810	625	312	31

After dealing with the question of possible injury to fish life, Mr. Kershaw gives the views of various persons and bodies regarding the dilution necessary for sewage discharged into fresh waters, bearing in mind that owing to the great variation in sewage liquors considerable difference of opinion is expressed in these views which are (some of them) as follows: In 1887 Dr. Miller considered 120 cubic ft. per minute per 1,000 persons to be sufficient to prevent nuisance. Taking the water supply then at 20 gallons per head per day, a dilution of 1 in 50 is obtained. At the present day 30 gallons of sewage per head per day is about an average figure for this country, and in the examples quoted respecting American practice it must be remembered that the sewages there are generally very much weaker than those met with in this country, varying from 50 to as much and more than 150 gallons per head. Probably 100 gallons per head would be an average figure.

Messrs. Hering, Williams and Artingstall, reporting on the Chicago Drainage Canal, recommended a dilution of 240 cubic ft. a minute per 1,000 population, equal to (assuming a sewage flow per head of 100 gallons) a dilution of 1 in 22. This figure was subsequently cut down to 200 c.f.m. per 1,000 population.

Mr. F. P. Stearus, reporting on the rivers of Massachusetts arrived at no definite decision, the debatable limit lying between 150 and 450 c.f.m. per 1,000 persons.

Mr. Hazen, reporting on the rivers of Ohio in 1898, found that where rivers were sluggish, or already somewhat polluted, the quantity required for dilution might be 360, 480, or even 600 c.f.m. per 1,000 persons.

Mr. Goodenough, chief engineer to the Massachusetts State Board of Health, referring to rivers discharging into inland waters, found that conditions are not likely to be objectionable when the dilution exceeds 360 c.f.m. per 1,000 persons, while there are always objectionable features when the dilution is less than 210 c.f.m. per 1,000 persons.

Other opinions are given by American engineers, from which it may be gathered that the expression of opinion given above by Mr. Goodenough is a fair average of these opinions.

Mr. Kershaw then gives the conclusions arrived at by the Sewage Commission of 1898, which can be referred to by our readers in the report issued by the commission, and he then goes on to say:—

"About the time that the officers of the Sewage Commission were engaged on the data for the eighth report, some most interesting results on the reoxygenation of still water at different depths were obtained by Col. W. M. Black and Prof. Earle B. Phelps. Prof. Phelps was communicated with, and he very courteously prepared a table giving dilutions for sewage liquors of varying strengths, with stream depths of 5 and 10 ft., and mixing periods of one and six hours, the dilution in each case being sufficient to prevent deoxygenation below 6 and 4 c.c. per litre. As stated on page 10 of the Eighth Report, table B (page 11) was deduced from Prof. Phelps' table. As the original table has not, so far as the writer knows, been published, it may be interesting to give it below. The figures in parentheses are taken from the commission's table B, and are inserted for purposes of comparison. It will be seen that they approximate closely to Prof. Phelps' figures.

Estimated dilution for various sewages in order that the dissolved oxygen of the stream shall not be reduced below 6 c.c. and 4 c.c. respectively, under assumed conditions of depths and periods of complete mixing:—

Mr. Kershaw says that when the sewage flow increases to an extent rendering the dilution afforded by the river barely sufficient, further treatment of the sewage may be necessary. If it is crude sewage, the suspended solids may have to be removed by screening or settlement. In tidal waters it may be advisable to store the sewage and discharge only on the ebb-tide. It may even be necessary to treat fully a part of the sewage, and to discharge this mingled with the tank liquor.

Having refered to Dr. Gilbert J. Fowler's recent paper on "Purification of Water by Activated Silt," he gives the conclusions arrived at by the consulting engineers in their report to the International Joint

Commission of Canada and the United States, on the problem as to what should constitute the limiting load to be imposed on a water purification plant which, inter alia, is as follows:—

"In waterways where some pollution is inevitable and where the ratio of the volume of water to the volume of the sewage is so large that no local nuisance can result, it is our judgment that the method of sewage disposed by dilution represents a natural resource and that the utilisation of this resource is profitable for economic reasons, provided that an unreasonable burden of responsibility is not placed upon any water purification plant, and that no menace to the public health is occasioned thereby. . . The nature of the sewage treatment required should vary according to the local condition and its remoteness from other communities, with the intent that the cost of sewage treatment may be kept reasonably low. In general, the simplest allowable method of sewage treatment, such as would be suitable for small communities remote from other communities, should be the removal of the larger suspended solids by screening through a ¼-in. mesh or by sedimentation." . . . The inquiry which the International Joint Commission undertook related mainly to the Great Lakes and the cities on their shores.

In conclusion, Mr. Kershaw deals with sea disposal by dilution, in which case he says complications arise, and local conditions must be carefully considered. Currents in the sea vary with the state of the tide, and there are undercurrents to be considered. Surface plants are subject to wind influences and may mislead. Several cycles of tides should be observed, and temperatures should be taken. He then quotes Belfast and New York as interesting examples of sewage disposal in tidal waters, and gives details of the amounts of dilution, which, in the case of Belfast, amounted to 1 in 2,000, and in New York to only 1 in 200, and consequently, as Mr. Kershaw remarks, "at certain points in the harbor offence both to the eye and nose occurred." Mr. Kershaw is to be heartily congratulated on his excellent article, which brings the question of sewage purification by dilution up to date.—The Surveyor.

The Good Roads Appeal

"The key-note of the good roads appeal seems to be largely directed towards the pleasure use of the roads," said the Hon. E. C. Drury, premier of Ontario, at one of the closing sessions of the good roads convention at Victoria, B. C. This is not altogether the case in Ontario, he went on to say, largely owing to the more thickly settled state of that part of the Dominion, and to the somewhat remarkable fact that the distribution of motor cars among the population of 2,000,000 is in the proportion of one car to every twelve persons. A situation of this kind, he said, in which practically one-half of the entire population could be set on wheels, is unparalled in the history of transportation, and has created a great democratic problem which, briefly stated, is that of as quickly as possible giving the benefit of goods roads, suitable to the new traffic requirements, to all the people. This means, not a great traffic canal, so to speak, designed to serve principally heavy high speed traffic between congested points, but a system of circulation like that of the human body, which will in its ramifications reach every part in exact accordance with the requirements.

Premier Drury then described the Ontario government policy in regard to the provincial road system, and the work being done by the county and township authorities. He laid emphasis on the fact that no particular type of road construction is favored, the general principle being to use materials found on the road allowance as far as practicable, with modifications to suit the conditions of traffic as altered by the rapid popularity of the motor car. He recognized the growing freight traffic on the highways as an expression of public desire. The motor truck has made it possible for fruit farmers to pick their crops of berries in the afternoon and deliver them at the market one hundred miles or more away early the next morning. Other classes of freight can be as quickly and efficiently handled, and the convenience of the method is such that the public will demand its recognition and that due provision will be made for it.

Concluding, he urged that reaction be guarded against. There is a danger that in meeting the new conditions the limits of sound business building may be overstepped and a situation analogous to the railways of the Dominion created. This can be avoided by proceeding slowly, having plans well digested in advance and not exceeding in our programmes the country's power to pay.

Reduction in Public Liability Insurance Rates

The Toronto Builders' Exchange have been endeavoring for several months to obtain a reduction in rates for public liability insurance, and they have now received advice from the Fidelity Agency of Canada Limited that at a meeting of the Casualty Underwriters' Association on June 15th, new rates were drawn up, involving some large reductions.

This form of insurance has not been very popular in Canada until the last two or three years. Within that period, however, a great demand has arisen, and companies have, therefore, just been placed in position to base their rates on their experience.

Some of the reductions are as follows, compared with the previous rates charged:

	New Rate	Old Rate
Steel erection	1.15	2.00
Alterations and additions to buildings	.15	1.00
Carpentry work	.25	1.00
Chimney constructions	.45	1.00
Concrete work—buildings	.25	1.00
Concrete work—sidewalks	.45	1.00
Masonry work	.45	1.00
Marble & stone setting away from shop—exterior	.45	1.00
Plastering	.15	.35
Plumbing	.15	.35
Sewer work	.85	1.00
Minimum premium	25.00	50.00

The rate for property damage, which may be included with public liability policy, is 40% of the public liability rate, with a minimum premium of $25.00.

The Department of Telephones of the Province of Saskatchewan has issued its annual report for the financial year, ended April 30, 1921, copies of which are now available.

The Contract Record's

Weekly House Suggestion No. 26

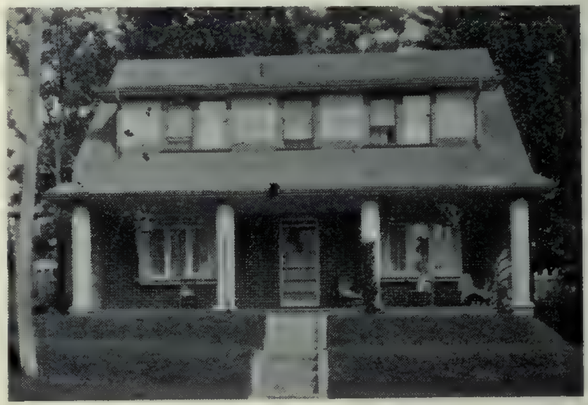
Stucco is a very prominent factor in the exterior beauty of this attractive, square-plan home, which is another of the many residences erected by Mr. H. Addison Johnston, in the Beach district, Toronto. The general exterior construction is brick on the first floor, with stucco on metal lath above, stucco also being used around the large bay window on the dining room.

The feature of the ground floor interior is the large living room with its handsome horse-shoe fireplace, on either side of which are built-in seats. This room, as are the other rooms on the ground floor, is trimmed with oak and has quarter-cut oak floors. The dining room is also large and is abundantly supplied with natural light by the beautiful bay window on the side. The dining room and kitchen arrangement, as seen on reproduced plan herewith, is very convenient and the latter room is thoroughly equipped with many modern service features.

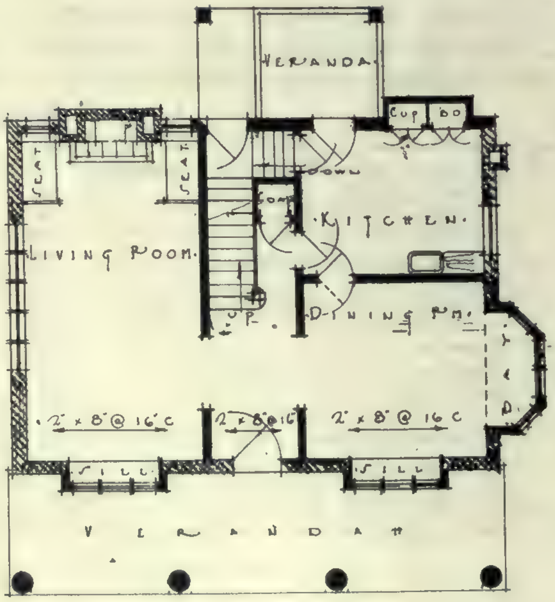
The location of the sun room in this house is unusual and is deserving of special note. It will be seen on plans shown below that this room, being available from the landing, has the advantage of accessibility from the ground or bedroom floors.

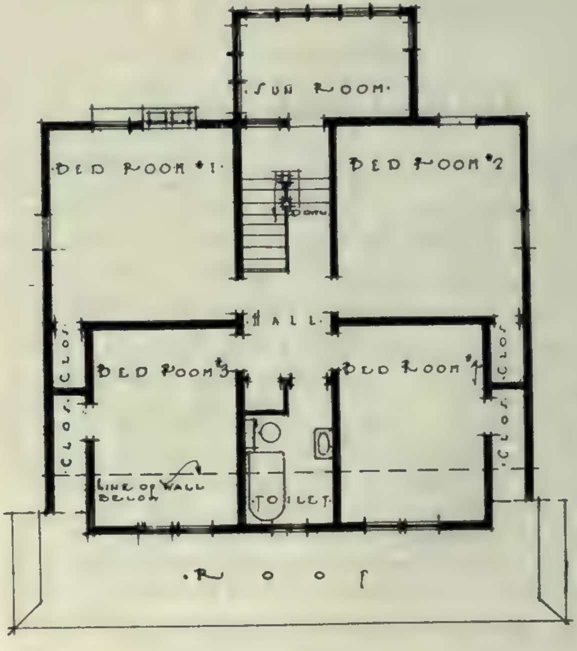
The bedrooms are all trimmed in pine, enamelled white, and the upstairs hall is trimmed in fir. The rooms are all bright and roomy and are well equipped with wardrobe and closet space.

There is a basement under the entire area of the house, divided into laundry, coal storage space and hot water heating plant.



The builder, Mr. H. Addison Johnston, 15 Silverbirch Ave., Toronto, has, in the construction of this residence, shown the possibilities for attractiveness in the simple, square-plan home.





The Ontario Gypsum Company

The attention of our readers is asked to the advertisement of the Ontario Gypsum Co., in this issue. This advertisement refers to the material supplied by this company in the construction of the Mount Royal Hotel. Owing to a misunderstanding it was omitted from our June 28 issue, which contained an 18 page description of that huge hotel structure.

Mainly Constructional

East and West—From Coast to Coast

A by-law to raise $382,096 for relief sewers will be introduced at the next meeting of the city council at Toronto.

Messrs. Stewart & Goffin recently purchased the building business of Mr. L. Williams, at St. Catharines, Ont., and are located at 33 North Street, that city.

$500,000 worth of the city of Winnipeg's bonds for housing purposes have been placed and the remaining issue of $300,000 will be available shortly.

The Federal Ironworks have opened offices and workroom at 1112 St. Patrick St., Montreal, and will carry on the business of dealers and erectors of ornamental iron.

Toronto's fire bill for the first six months of the year was nearly a half-million dollars. The total damage to buildings and contents was $431,575, the loss to buildings being $138,985 and to contents $292,590.

The mill of the Northern Construction Company, at Kamloops, B. C., was totally destroyed by fire recently, at an estimated loss of $100,000. About two and a half million feet of lumber were also destroyed.

By-laws for the erection of new car barns, the purchase of new cars and the double-tracking of a stretch of single tracking will be voted on by the ratepayers of Kitchener, Ont., sometime during the month of August, it has been announced.

The firm of Sutcliffe & Neelands, of New Liskeard, Ont., has been incorporated as a limited company and will be known as Sutcliffe & Neelands, Limited. The head office of the new firm will continue to be at New Liskeard and the capital is $50,000.

It has been decided that the proposal to raise $200,000 for an athletic stadium at Toronto to be erected on the waterfront east of the Exhibition grounds, must be submitted to the ratepayers. A by-law will therefore be voted on by the ratepayers at an early date.

A recent report states that the British Empire Steel Corporation is planning extensive additions and repairs to its plant at Sydney, N. S., and engineers are at present preparing plans for new open hearths and blooming mill. The work will include the rebuilding of one blast furnace and the repairing of another.

A recent report is to the effect that there is a likelihood of the resumption of work on the dry dock at Esquimalt, B. C., which was suspended shortly after the new King government went into office. The sum of $1,000,000 was included in the supplementary estimates brought down recently, for the continuation of this work, and it is expected that the contractors, Messrs. P. Lyall & Sons, will shortly be given authority to resume work.

Messrs. Robertson & Kendell, Ltd., a branch of Robertson & Partners, have been awarded the contract for the extension of the concrete dam at Ocean Falls, at the head of Cousins Inlet, 300 males north of Vancouver. This contract will involve the expenditure of about $250,000 and will include a 15 ft. addition to the height of the existing retaining wall, the new wall to be 650 ft. long, 35 ft. thick at the base and 10 ft. at the top. A large paper company at this point depends upon its water supply from this dam.

The difficulties between Mr. John Pearson, architect for the new parliament buildings at Ottawa, and the Dominion Government, will be considered by the following special commission composed of three representatives, one from each of the parties, who will determine Mr. Pearson's right to the extra commission claimed for his work in connection with the above contract: Messrs. H. Marler, (St. Lawrence-Montreal, representing the Liberals); F. White, (London, the Conservatives); and Robert Forke, (Brandon, the Progressives).

Building permits issued at Port Arthur, Ont., for the six months of 1922, ending June 30, amounted to $910,102.00, as compared with $78,327.00 for the same period of last year, being an increase for 1922 of $831,775.00, or more than 1,000 per cent., according to figures given out recently by the building permit branch of the city engineer's department. The prospects for the remaining six months are fair. Industrial expansion is responsible for the greater portion of the 1922 permits, which includes a paper mill addition to the Port Arthur division of the Provincial Paper Mills, Limited, to be completed by December 1.

Personal

Mr. George A. Zimmerman resigned as alderman of the city of Kitchener, Ont., recently to take over his new position of civic building inspector. Mr. Zimmerman is an experienced plumber and is conversant with the building requirements of the city and for these reasons was favored by the council for the position.

Obituary

Mr. Alfred D. Learoyd, prominent contractor of Windsor, Ont., died recently at his home in that city after an illness of six months. Deceased was 62 years of age.

Mr. Robert Harmer, president of the Sawyer-Massey Company, Ltd., of Hamilton, died recently at his home in Toronto. Mr. Harmer was born in Essex, England, 69 years ago, but came to this continent at an early age. He located in Toronto in 1879 and was instrumental in the founding of the Massey-Harris Company in that city. He later became connected with the Sawyer-Massey Company, becoming president of this company. Deceased was also president of the Canada Furniture Co., Woodstock, Ont.; president of the Seaman Kent Co. Ltd., of Toronto, and a director of the Gray Dort Motors, Ltd., Chatham.

Mr. William Newman, superintendant of the wrecking department of the John E. Russell Construction Co., Toronto, was accidentally killed recently when he fell into the hold of the steamer Joyland. Deceased was born in Kingston 49 years ago and began his career with Mr. John Gaskin in that city, as naval architect. He was also with the Donnelly Wrecking Company, of Kingston, the Bertram Shipbuilding Co., of Toronto, and about 10 years ago became connected with the Polson Iron Works Co., of Toronto, in the capacity of naval architect and yard manager, where he remained until the closing down of this firm. He joined the John E. Russell Company two years ago.

CONSTRUCTIONAL ACTIVITY

Period of July 4 to July 11, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Bosanquet Twp., Ont.
Bosanquet, Stephen, West Williams and McGillivray Twp. Councils will construct drainage system to cost $60,000. Geo. A. McCubbin, Engr., 135 King St., Chatham, Ont.

Cayuga, Ont.
R. S. Colter, Town Clerk, has plans and will receive tenders until July 15th for construction of concrete pavement.

Durham, Que.
Road costing $20,000 is being constructed by Town, work by day labor. A. J. Lyster, secy.

Grimsby, Ont.
Town Council will construct extension to intake pipes, and pier, work by day labor under supervision of Mr. Bromley, Engr.

Maidstone Twp., Ont.
A. C. Mousseau, R. R. No. 1, South Woodslee, secy.-treas. Maidstone Twp. Council, will receive tenders until July 17th for drainage improvements.

Oakville, Ont.
Percy A. Bath, Town Clerk, has plans and will receive tenders until July 17th for concrete pavement, sidewalks, curbs and gutters. Plans also with Jas. A. Bell & Son, Engrs., Court House, St. Thomas.

Thornbury, Ont.
E. Rorke, clerk, will receive bulk and separate tenders until July 15th for material and construction of sewer. James, Proctor & Redfern Ltd., Engrs., 36 Toronto St., Toronto.

CONTRACTS AWARDED

Dresden, Ont.
General contract for construction of concrete pavement costing $60,000 for Town is awarded to Cadwell Sand & Gravel Co., 228 Sandwich St. W., Windsor, Ont. W. G. McGeorge, Engr., 153 Queen St., Chatham.

Fort Frances, Ont.
General contract for construction of concrete pavement costing $33,941 for Town is awarded to John East Co., Fort Frances.

Grimsby Twp., Ont.
Contract No. 594, asphaltic concrete pavement for Prov. Gov't., is awarded to Warren Bituminous Paving Co. of Ontario Ltd., 54 University Ave., Toronto.

Lindsay, Ont.
General contract for construction of macadam road on Colbourne St. for Town is awarded to Standard Paving Ltd., Central Chambers, Ottawa. Oliver Smith, Engr.

St. Catharines, Ont.
Contract No. 198 for concrete road costing $75,000 for Prov. Gov't. is awarded to Frid Construction Co. Ltd., Clyde Block, Hamilton.

Windsor, Ont.
City Council awarded contracts for paving on following streets: Wyandotte St., Merlo, Merlo & Ray, Ford City, Ont.; Louis Ave., Chick Contracting Co. Ltd., McDougall Ave.; Pitt St. and Bruce Ave., Cadwell Sand & Gravel Co., 228 Sandwich St. W. M. E. Brian, Engr.

Yellow Head Pass, B. C.
General contract for roadwork costing $61,000 for Prov. Gov't. is awarded to Cotton Co. Ltd., False Creek, Vancouver.

York Twp., Ont.
Twp. Council awarded following contracts for pavements and grading: Dunvegan Rd., $8,000, Kilmer & Barber, 24 Adelaide W., Toronto; Forest Hill Rd., $7,400, Constructing & Paving Co., Confederation Life Bldg., Toronto; Normanna Ave., $7,500, Godson Contracting Co., Manning Chambers, Toronto; Bicknell Ave., Britnell Contracting Co., Baxter St., Toronto. F. Barber, Engr., 40 Jarvis St., Toronto.

Railroads, Bridges and Wharves

Boston Bar, B. C.
C. N. Rlys. will rebuild bridge at cost of $30,000.

Petrolia, Ont.
Michigan Central Rly. will construct spur line. Alex. Leslie, Engr., M. C. R. offices, St. Thomas, Ont.

Port Bruce, Ont.
Dom. Gov't., Dep't. Pub. Works, contemplate repairing pier and harbor.

CONTRACTS AWARDED

Montreal, Que.
Contract No. 2 for wharf for Harbor Commrs. is awarded to Sterling Construction Co., P. O. Box 336, Montreal. T. W. Harvie, Engr.

Orangeville, Ont.
Dufferin County Council awarded following contracts: 100' reinforced concrete arch truss, $8,374, Jno. Langdon, Kenilworth, Ont.; 2-85' reinforced concrete arch truss, $12,055, John Kidd, Inglewood, Ont.; culverts, Alfred Arnott, Conn, Ont.

Public Buildings, Churches and Schools

Baie St. Paul, Que.
School Bd. contemplate erection of school. C. Simard, secy.

Bobtail, Alta.
Plans are being prepared for school for Bobtail S. D. No. 4107. A. Liddle, secy.-treas., Ponoka, Alta.

Brantford, Ont.
Rev. Albert Carr, 24 Edwin St., has plans and will receive tenders, no closing date set, for erection of church to cost $20,000. J. F. Brown, architect, 105 King E., Toronto.

Brody, Alta.
Brody S. D. No. 1783, will erect addition to school. John Galinowski, secy.-treas., Mundare, Alta.

Chicoutimi, Que.
Erection of school is contemplated by School Bd. J. D. Villeneuve, secy.

Conrad, Alta.
Erection of school is planned by Conrad S. D. No. 4077. E. W. Holroyd, secy.-treas., Boyne Lake, Alta.

Dubuc, Alta.
Plans are being prepared for school for Dubuc, S. D. No. 4116. O. Balcaen, secy.-treas., Vegreville, Alta.

Harewood, Alta.
E. W. Smith, Dewberry, secy.-treas. Harewood S. D. No. 4112, has plans and will receive tenders until July 19th for erection of school.

Lac Aux Sables, Que.
Erection of school is contemplated by School Bd. O. Chavigny, secy.

Living Spring, Alta.
Plans are being prepared for school for Living Spring S. D. No. 4114. R. D. Sigman, secy.-treas., Benton, Alta.

London, Ont.
Brig. Crighton will receive tenders, no closing date set, for rebuilding Salvation Army Citadel.

Moncton, N. B.
Erection of high school costing from $50,000 to $75,000 is contemplated by School Bd. Amos O'Blensis, secy., Victoria School.

Montreal, Que.
Jos. Venne, architect, 402 Plessis St., has plans and will receive tenders until July 15th for erection of church for Parish of Sacred Heart, 835 Ontario St. E.

J. D. Pilon, secy. Catholic School Cmsn., West District, 2198 St. James St., has plans and will receive tenders until July 20th for erection of St. Clothilde school and residence to cost $200,000. Plans also with Chas. David, architect, 3 Burnside Place.

Mount Forest, Ont.
Pub. School Bd. plan alterations to school. S. J. Short, Chrm.

Mundare, Alta.
Rev. Father Roe, St. Joseph's Convent, Mundare, will receive separate tenders for general plumbing and heating contracts for erection of college to cost $20,000.

Rowley, Alta.
Plans are being prepared for school

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director

HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL	119 Board of Trade Bldg.
WINNIPEG	302 Travellers' Bldg.
VANCOUVER	Winch Building
NEW YORK	296 Broadway
CHICAGO	14 West Washington St.
LONDON, ENG.	16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U.S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 **Toronto, July 19, 1922** **No. 29**

"Selling" Highways to the Public

A new phase of the highway problem that is assuming importance in the minds of engineers is drawn attention to by our contemporary "Engineering News-Record" which states that until recently chief consideration has been given to financing, design, construction, and maintenance. Now, however, that the various highway departments have made substantial progress in spinning their traffic webs between important centers to form an interconnected system, the problem of operation looms large. For the most part the highway departments have reasoned thus: Our job ends with the construction and maintenance of roads; let the public use them as it will. Today, however, according to the "News-Record," we find certain highway departments—Wisconsin is an example—going a step further, by selling its product to the road user. To accomplish this end the Wisconsin department has each year for several years issued an excellent map of the state trunk highway system. The latest edition contains forty-eight pages folded to a convenient pocket size. There is shown first a key map of the entire state, followed by maps, on a larger scale, of different sections. All routes are numbered and the condition and surfacing are indicated in every case by the use of different conventions, red, black, and purple ink being employed. In addition, the maps indicate points of historical, scenic, and industrial interest, camping sites, state parks. There is a real business return for the state in such a publication as this. Increased highway traffic turns revenue not only into the hotels and shops, but into industries of all kinds. In this country the development of tourist traffic as a means of paying indirectly for road construction and maintenance has been almost entirely neglected. Highways can be made to yield dollar-and-cents returns just as surely as does Swiss scenery if the technical conception of them can be leavened by a proper amount of promotional instinct. In this there is a worth while suggestion for our own provinces, now that they are actively engaging in intensive road improvement.

Hydro-Electric Development

During the past decade or two, ever-increasing attention has been centered upon a development, which, in its enormous potentialities, promises to play a vitally important role in the development of the Dominion. This is the production of hydro-electric energy.

That this industry has been becoming more and more important in recent years, is due to various factors. The continuous rise in the price of fuel, as well as the diminishing supply, has induced a search for substitutes, and hydro-electric power has proved its value in this field. Furthermore, the growing complexity of transportation problems suggests a wider use of electric power. Another factor is the ability, due to recent technical improvements, of transmitting power of high voltage a much longer distance than formerly was possible.

With respect to the amount of hydro-electric power already developed, as well as the potential supply, Canada stands among the foremost of the nations of the world. Nor has the Dominion been slow to realize the tremendous possibilities of this important resource. That a creditable showing was made during 1921 in the development of water power in Canada, is indicated by reports recently published by the Department of the Interior. In these reports, it is shown that, in spite of general conditions of depression throughout the country, over 300,000 horse power was added during the year 1921.

From the standpoint of the distribution of hydro-electric power in Canada, the central electric station industry is of prime importance. The fact, previously referred to, of the greatly extended radius of electrical transmission, in addition to the fortunate location of water power with relation to centers of industry, has led to the widespread development of central electric stations. It is estimated that at the present time there is invested in hydro-electric plants and systems, engaged in the production and distribution of electrical energy, over $437,000,000. This investment represents a horse power of 2,013,000, generated in 282 central stations. Of this amount, the pulp and paper industry used over 160,000 horse power, in addition to the 476,000 horse power generated directly by the pulp and paper companies. Other industries used over 274,000 horse power.

Canada's Record

The recent development of water power in Canada compares very favorably with that of other countries. Compare the Canadian record, with that of the United States, for example: In 1902, Canada added 47 h.p. per thousand of the population, in comparison with an addition in the United States of 26 h.p. in the same year. In 1912, the Canadian figure was 198, and the American figure 51. In 1920, the Dominion installed 200 horse power, and the United States 93 h.p., per thousand of the population.

With these important additions, the developed water supply of Canada now totals well over 2,763,000 h.p., with considerable construction under way. This gives Canada the distinction of having the largest per capita development of any country in the world, with the one exception of Norway. The near future should see tremendous strides in this vitally important industry. Canada is eminently fortunate in her water power resources, both in respect to amount and seasonal distribution of rainfall, and also from the standpoint of the nature, extent and location of the sources. In the past, prospective water power sources have been thoroughly investigated and intelligently administrated. It is scarcely possible to exaggerate the vital importance of this industry, not only in relation to its use for light and heat, but more particularly in view of its tremendous value in the development of our other natural resources.—Royal Bank of Canada.

The Benefits of Co-operation

Address of Herbert Hoover Before the American Construction Council—What it is Possible for the Building Industry to Accomplish

I regard this meeting as an event of first importance. There have been great numbers of efforts to bring the construction industries into some sort of unity of organization for the promotion of the better and higher purposes of the industry and up to the present time while many of these efforts have been fruitful of great results there has not been a successful organization of the industry as a whole.

The organization of the construction industries so that they shall perform their best and highest functions is one of the things that we need above all others. There are an almost infinite number of fields in which the individual manufacturers, the individual contractor, the individual engineer and architect can do practically nothing in the forwarding of these industries in those directions that make not only for public interest but for the interest of the industries themselves and we have long since passed the time when purely individualistic action was of avail; there must be co-operation in our industries if we are to secure the most effectual relations from the industries, the greatest stability in the industries themselves and the greatest national service out of their functions.

Where Co-operative Action is Needed

There are a great number of directions in which co-operative action can be had. One of the problems that the Department of Commerce has been concerned with since this administration has come in has been that primary question of the kinds and qualities of materials; the establishment of standards as to the quality and as to the nomenclature by which the quality is described; in the lessening of freight on one thing; in the maintenance of better repute of the different contributing industries; in the lessening of litigation and the hundreds of other benefits that come from that one problem alone. There are problems of inspection of material, of the simplification of dimensions in material, that we may eliminate as much waste as possible both in the preparation of material and the volume of goods that must flow into distribution, the waste that must come in materials not adapted to their primary and many other elements. There is the question of specifications and contracts, the question of statistics and the primary fact that no industry can be conducted without stability. No business man can form right and proper judgments as to his own policies and course of action unless he is properly informed. Information of that type can not originate in the individual; it must take place by joint action in the collation and securing of that type of knowledge in a hundred directions. It ought to be possible for every business man to know the production and consumption of his commodity promptly monthly and annually. It ought to be possible to know the volume of construction in progress, to know the demand among all of the construction industries so that their plans may be made and their materials laid out long in advance of its consumption, and unless there can be better judgment than there has been as to the probable need, we will always have a very high degree of speculation in these industries.

There are a great many problems connected with home-building, encouragement of home ownership, the zoning of cities, the establishment of proper and economical building codes, the great problems of labor, the problems of seasonable employment, the reduction of the intermittency of employment of labor, the encouragement of those agencies that devoted themselves to the limitation of jurisdictional disputes, the advancement of apprenticeships, of educational training and, in fact, probably a hundred avenues where co-operative action is needed; not knowledge for increase of efficiency in industry, but for the maintenance of its own stability and by elimination from it of unnecessary speculation and, in fact, for a better functioning of industry in relation to our national needs.

I scarcely need to go into detail with regard to these questions and the fine and effective possibilities that lie in them. They are not things that can be solved over night. They are certainly things that can not be solved unless there is co-operative action in industry. I am one of those who believe that through activities of this kind, these matters that are of vital public interest, there can be no successful issue unless they arise from the initiative of the industry itself. I do not believe these results can be accomplished by bureaucracy or government regulation and therefore if we would stem the tide of regulatory powers of government in an endeavor to answer every complaint arising in the country by which we now curtail the progress of industry itself, we would do much and in the organization of this Council you will have taken a great and fundamental step toward that end. It is a step I have long looked for—advocated—during the past year. We have made some attempts to secure solution and I do believe that in bringing all the elements in the construction industry here to see whether or not joint action can not be secured, you are taking one of the most important steps ever taken. . . .

Elimination of Shoddy Construction

Shortage of Housing Tends to Increase Hasty and Flimsy Methods —Owner Often at Fault—Building in a Substantial Manner is Economical in the Long Run

Because of the rapid growth of the country and the natural shifting of the centres of population, we have not been accustomed to the erection of buildings designed to endure for centuries, such as will be found in most European countries, where even the farm houses and homes of the peasantry are of stone and brick. With the tremendous shortage of housing to be made up and with the inevitable increase in the cost of structural material, the natural temptation may be towards hasty and even flimsy construction. A strong note of warning against this was sounded in an address made by Lyman Clark, of the General Electric Company, Schenectady, N. Y., on "The Danger of Shoddy Construction," before the convention of the construction industries held under the auspices of the Chamber of Commerce of the United States in Washington.

Building construction in the United States, says Mr. Clark, involves the expenditure annually of an amount probably equal to three billion dollars. The very smallest economic effect upon this expenditure naturally involves a large sum of money and we may readily afford considerable expense in devising methods for its economic use. As an example, if our annual outlay for building construction can be affected by only such a small amount as 1 per cent for good or for evil, or 1 per cent positive value and 1 per cent negative value, we have the possibility of creating a saving account of 2 per cent, or sixty million dollars annually, which is the interest charge at 6 per cent on a total of 33 1/3 per cent of our annual expenditure. With this large saving in mind, is it not worth while to seriously look ahead and devise every possible means for the reduction and prevention of shoddy in building construction?

Causes for Shoddy Construction

"There are many causes for shoddy construction that are traceable to the ownership of property. We look upon property in the sense of invested capital upon which we must seek a financial return. Our constant thought is to develop the property for one purpose or another, that it may make a return on the invested capital. From the standpoint of building construction the owner is always confronted with the problem of what best can be done with his property from two points of view; he must consider the property in the light of a holding with ever increasing value or he must consider it in the light of something to be traded in as an article of commerce. Where the owner has adopted the latter consideration, there springs up within our urban and suburban centres an enormous amount of building construction.

"There is a cause for shoddy construction where the owner tries to seek a greater earning increment by attempting to build beyond his means. Without sufficient capital requirements, he often places upon the property a building of the dimensions and contents he desires by utilizing shoddy construction. In other words, he is forced to build beyond his borrowing ability.

A Premium on Good Construction

"While it may be a delicate question to impose upon him who loans funds for building purposes, a further consideration than the return of interest and principal, there, however, seems to be a growing consideration that financiers must be more concerned with this question than they have been in the past. The mortgagee of property should be concerned not only in the assurance that principal and interest are returned, but that the loan has been wisely and judiciously invested. It should be the duty of one loaning money for building to know that the character, kind and quality are the best within economic means. The life of building structures has been variously estimated as being for cheap frame tenements of from ten to fifteen years and for the best structural buildings of from seventy-five to one hundred years. A rate for sinking funds would then be 10 to 5 per cent for the cheap frame tenements for a term of nine to sixteen years. In the structural buildings the rate of the sinking fund would only need to be 1 per cent. and the term only one-half its life. Therefore, we may reduce the introduction of shoddy construction by impressing upon the owner the economical considerations of building well, and further, by making it difficult to obtain loans for shoddy construction. We may be able in this way to reduce shoddy construction by placing a premium upon good construction.

"We have comparatively few cities with what are municipally known as building codes and none of these codes absolutely prohibit the use of shoddy construction. In the majority of cases they are made out merely to prevent fire hazard rather than to create good construction. Attempts have been made, however, to clarify and unify many regulations imposed upon the building structure. We may, therefore, hope by this means to greatly reduce shoddy construction in future buildings.

Reducing Shoddy by Co-operative Effort

"Probably no better means for reduction of shoddy is provided than through co-operative effort stimulated by trade associations. There has been a tremendous amount of work done by trade associations in setting up useful and economic standards that have materially reduced the waste in building structures. There is still a great deal of work to be done and it would seem worthy to propose that, wherever possible, various trade associations should be notified by the architectural profession, by the engineering societies and by various contractors' associations of anything that will tend to reduce the use of shoddy by its removal from the market.

"We are confronted today in the construction industry with the price of labor sufficient to necessitate the use of only good material and certainly entire elimination of shoddy material. It is impossible to conceive of paying the prevailing rates of labor for the introduction of shoddy. If one will undertake to examine the material in the market, it will be clearly and easily seen that the use of good material does not vitally affect the cost of building structures; that those concerned with building operations do not examine thoroughly the market price of commodities, in planning building structures must be evident.

"In residential building, we are confronted with a condition where about one-half the cost goes to labor and one-half to material. Eliminating certain items of material that are by an average amount equal to 10 per cent., we can figure on obtaining a home in the definition of Webster: 'The abiding place of affections.' Generally, quality may be obtained at an expense of only 2½ per cent. of the total cost. Sometimes, through the application of knowledge, the same is true without any increase in the investment.

"Shoddy as meaning 'waste' must be eliminated if we are to approach any economical refinement. Therefore, may I suggest that all interest in building construction, the banks, insurance companies, merchants, industrial, professions and trades interest themselves in every means available for the reduction and elimination of shoddy construction."

Concrete Pavement Construction in Hot Weather

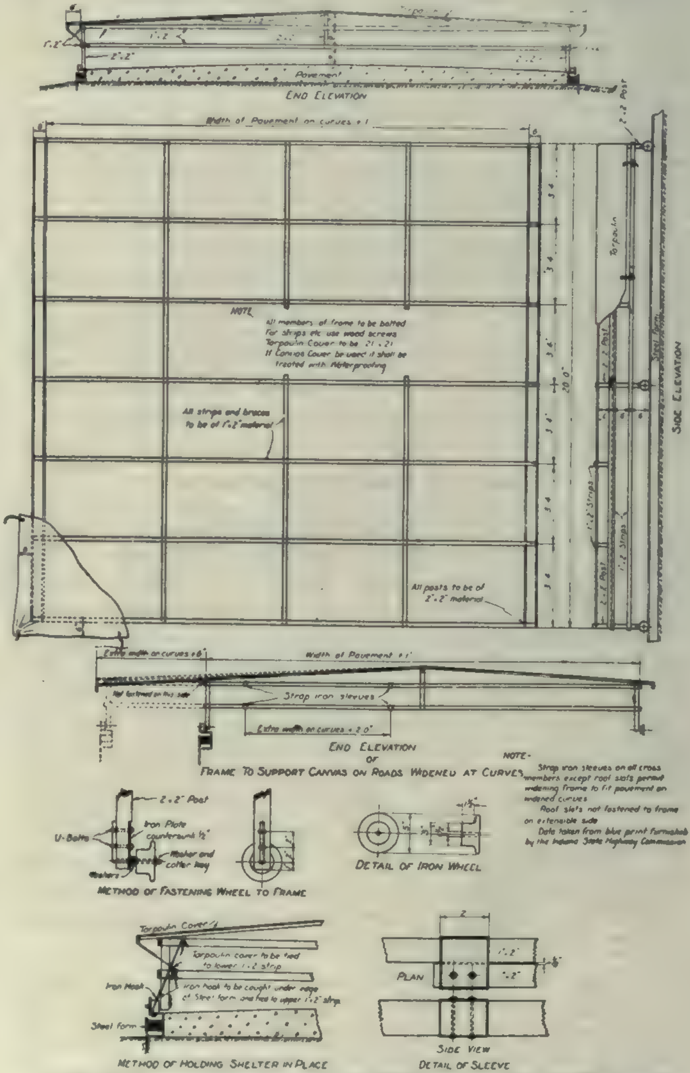
Measures to be Taken to Ensure Satisfactory Results in the Summer Season—Protection Against Evaporation of Necessary Moisture is the Chief Essential

Most concrete pavement construction is in progress during the hottest portion of the year and under such circumstances there are a number of precautions to observe. This fact makes it opportune to refer to a pamphlet issued some time ago by the Portland Cement Association entitled "Concrete Pavement Construction in Hot Weather," from which several extracts are taken. When suitable measures are taken to protect the pavement from hot sun and drying winds the strength and wearing qualities of the pavement will be greatly improved, due to the fact that moisture is a requisite to the hardening process of the concrete mixture. As the hardening of concrete is not a drying process, the newly laid pavement must be protected against evaporation of necessary moisture. Concrete hardens best and most uniformly in the presence of moisture. Water used in mixing is required for the chemical changes that take place during the hardening process. Concrete mixtures may be properly proportioned, of correct consistency, and all other details requisite to good construction carried out, yet if the new stock is exposed to hot sun or drying winds, its final strength will fall below the maximum obtainable.

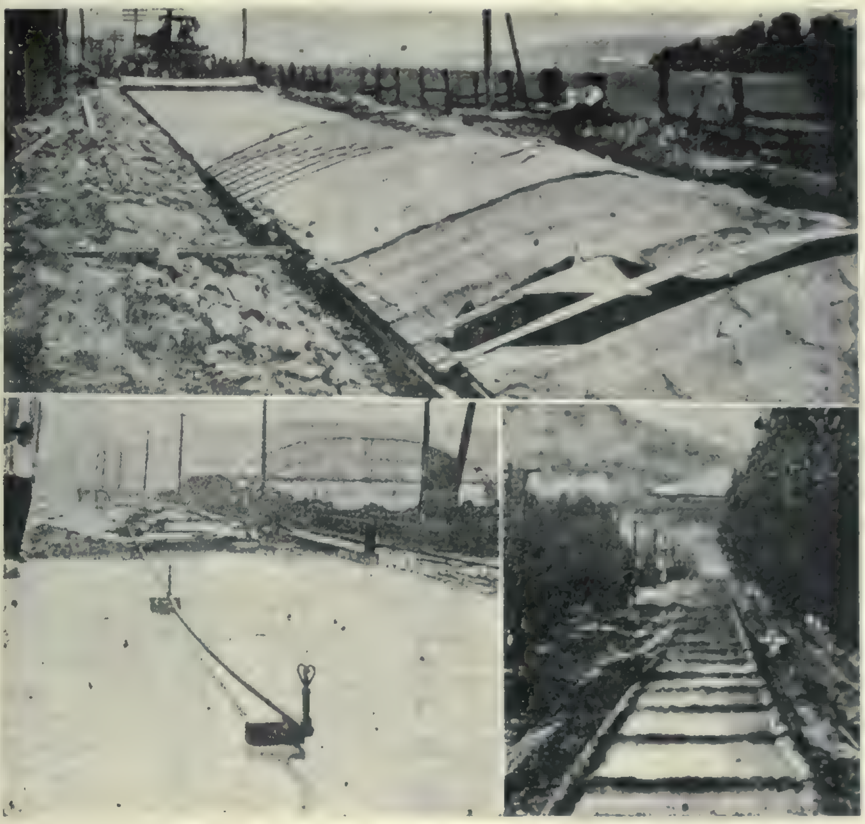
Direct heat from the sun and drying winds from across open fields must be guarded against on concrete roads under construction. Residence streets are often partly shaded by trees and because of this are subjected to uneven hardening unless the concrete is protected. One cause of evaporation of water from newly placed concrete on street and alley work is heat reflected from buildings adjacent to the pavement. The walls of a building exposed to the sun will continue to radiate heat for some hours after direct rays of the sun no longer strike the building surface. This situation always demands close attention and extra care must be taken to protect new concrete in such locations.

Prevention of Shrinkage Cracks

A feature of concrete pavement construction, which sometimes gives trouble in hot weather, is the formation of fine irregular cracks in the surface after the finishing has been completed and before hardening has fully commenced. When such cracks occur, they are usually caused by unequal shrinkage of the concrete, the exposed surface drying out slightly


Tarpaulin
1"x2"
2"x2"
Pavement
End Elevation
2"x2" Post
Width of Pavement on curves + 1'
NOTE
All members of frame to be bolted
For strips etc use wood screws
Tarpaulin Cover to be 21 x 21
If Canvas Cover be used it shall be treated with Waterproofing
All strips and braces to be of 1"x2" material
All posts to be of 2"x2" material
Tarpaulin
2"x2" Post
Steel Form
Side Elevation
20'0"
1"x2" Strips
Extra width on curves + 6"
Width of Pavement + 1'
Not fastened on this side
Strap iron sleeves
Extra width on curves + 2'0"
End Elevation of Frame to Support Canvas on Roads Widened at Curves
NOTE-
Strap iron sleeves on all cross members except roof slats permit widening frame to fit pavement on widened curves
Roof slats not fastened to frame on extensible side
Data taken from blue print furnished by the Indiana State Highway Commission
2"x2" Post
Iron Plate countersunk ½"
U-Bolts
Washer and cotter key
Washers
Method of Fastening Wheel to Frame
Detail of Iron Wheel
Tarpaulin Cover
Tarpaulin cover to be tied to lower 1"x2" strip
Iron Hook
Iron hook to be caught under edge of Steel form and tied to upper 1"x2" strip
Steel form
Method of Holding Shelter in Place
2
1"x2"
Plan
Side View
Detail of Sleeve

A movable frame, which rolls on the side forms, for supporting canvas cover for newly laid concrete. The frame can be securely anchored to the side forms to prevent overturning by high winds. It can be adjusted to extra pavement widths on curves.



Upper: Concrete road should be protected immediately after laying by canvas spread on light frames

Lower right: The ponding method of curing is an excellent system on level stretches.

Lower left: For city streets sprinkler heads connected to water supply form a convenient method of curing.

while the lower portions retain the normal amount of moisture.

After such cracks have formed the only effective method of closing them is to go over the surface again with finishing belt or paving roller until the hardening is well advanced. Any form of agitation or working of the surface during the hardening period usually results in closing such cracks as they form, or in preventing them from opening.

The method of avoiding shrinkage cracks in the finished pavement will be found satisfactory in the great majority of cases. Under extreme conditions of heat, particularly when a hot, dry wind blows over the pavement, the following procedure may be found necessary: Cover the pavement for its entire width with strips of burlap as fast as the finishing is completed. The burlap cover should be sprayed with water from an atomizing nozzle, so that the burlap will be kept damp and thus prevent evaporation from the concrete beneath. This form of protection can be effectively accomplished by providing lengths of suitable pipe with water under pressure, placed alongside the pavement or at intervals transversely, the pipe having enough openings with atomizing jets to permit a fine mist to play over the entire burlap-covered surface until the hardening has advanced beyond the stage during which shrinkage cracks will form. The burlap cover is essential to prevent the spraying water from collecting in such quantities as to form rivulets which might injure the fresh concrete surface.

Canvas Covering

When the hardening of the concrete has progressed to that stage where there is no longer danger of shrinkage cracks forming, it may still be too soft to permit ponding or covering with earth. Even though hardening may be well advanced, evaporation will take place from the surface unless suitable protection is given. This can best be provided by suspending over the pavement a protecting cover of canvas. The illustrations show how this has been accomplished by various contractors. Frames are provided which span the pavement and support the canvas cover at a suitable distance above its surface. In some cases these frames are designed to be carried from place to place by the workmen and are merely laid across the surface. In other instances it is found helpful to provide a frame with small wheels which will travel on the side forms, permitting the entire frame and canvas covering to be pushed ahead as the work progresses. Many contractors find these frames effect a worthwhile saving in time and canvas covering. They are inexpensive and easily constructed. The canvas cover should not be removed until the concrete is hard enough to permit ponding, or covering with a layer of earth or sand.

Curing By Ponding

The ponding method of curing is usually preferred on level stretches of pavement or sections where the gradient does not exceed two per cent. After the canvas covering has been removed and the surface of the fresh concrete sprinkled with water, dikes of earth are built along the sides of the pavement to a sufficient height to maintain a two-inch depth of water over the crown. To prevent too great a loss of water by seepage, a secondary longitudinal dam is sometimes constructed about two feet in from the edge of the pavement. This helps to insure the necessary depth of water across the crown of the section. Transverse dikes are built across the pavement at suitable intervals. On gradients up to two per cent or more, the transverse dikes must be spaced at such intervals that the required depth of water will be maintained on the down-grade side of the next higher cross-dike. This results in providing a series of ponds in the length of the pavement being cured. The ponds are usually filled at noon or at night or at other intervals in the concrete mixing so as not to deprive the mixer of a constant water supply with uniform pressure. Water is kept on the pavement in this manner for at least ten days and often for two weeks. When the hardening has progressed to the desired stage, the dikes may be broken and the water allowed to drain away or to evaporate as may be most convenient.

At the end of ten days or two weeks, hardening will have progressed so far that weather conditions are not likely to affect the strength of the concrete adversely. Traffic must be kept off the pavement, however, and it is good practice to keep up the barricades until the concrete is thirty days old. This length of time is particularly desirable if the pavement is built for heavy truck traffic.

Curing By Earth Covering

An earth covering is often used instead of the ponding method. After the canvas protection has been removed and the concrete has been sprinkled with water, a covering of sand, earth, marsh grass, hay, or other water retaining material is spread evenly over the pavement to a sufficient depth. The use of hay, straw, or marsh grass for covering has several advantages over earth. Such material, when spread in a layer four to eight inches deep, has excellent moisture retaining qualities. It can be raked up easily, loaded and hauled ahead, and re-used. It is frequently much cheaper than earth for covering. Any covering must be thoroughly soaked at intervals frequent enough to prevent it from drying out completely. Sprinkling of the cover should continue throughout a period of two weeks and the cover itself be allowed to remain on the concrete for a week longer. It is important to see that the vertical edges of the pavement slab are protected, as well as the slab surface. This is easily accomplished by banking a sufficient depth of covering material against the edges. In many instances it is found advisable to build dikes along the margins to help retain the moisture which is applied to the cover by sprinkling. In cool weather when the hardening of concrete proceeds more slowly, it may be necessary to lengthen the period during which traffic is excluded from the pavement after the application of moisture has been discontinued. This detail should at all times be under the control of the engineer in charge.

Prevent shrinkage cracks or "hair checks" by rolling and belting until hardening is well advanced

Curing By Sprinkling

On city street pavements it is frequently inconvenient or impossible to protect concrete pavements during the curing period either by ponding or by earth covering. In such cases the concrete may be kept wet by means of sprinkler heads arranged at suitable intervals and connected by hose to the city water supply or the contractor's pipe line. When the street is on a slight gradient the line of sprinkler heads may be so arranged that the water flowing down the grade will cover all portions of the pavement and thus reduce the number of outlets which must be provided. In arranging to cure the concrete by this method it is necessary to plan the work so that the water running off the pavement being cured will not flow over newly placed concrete or onto subgrade soon to be paved.

Barricades and Provision for Traffic

Substantial barricades must be erected and maintained at all points where traffic will approach or cross the pavement being built. The thoughtful engineer and contractor will see to it that the public is directed to the most convenient detour around the section closed to traffic. In some instances where traffic cannot be detoured it will be necessary to provide cross-overs. The most adequate provision for a cross-over is a temporary bridging structure of suitable timbers so arranged that no pressure will be transmitted directly to the pavement itself. When this is impossible, it is best to cover the pavement with a layer of earth or sand not less than ten inches deep on which wooden planking is then placed. This protective covering should extend on each side several feet beyond the necessary width of the cross-overs. The earth or sand cover underneath the planking will prevent severe shocks from being transmitted to the green concrete underneath. In some instances considerable lengths of new pavement have been covered and planked in this manner and traffic accommodated over routes where no detours were possible. In no event, however, should traffic on such a cross-over or cover be permitted before the concrete slab is at least three days old.

For public convenience, detours around sections of pavement under construction should be plainly marked.

Conditions Making Protection Unnecessary

In general, the protective measures described in the preceding paragraphs may be omitted when the temperature is 50 degrees Fahrenheit or below. Under such conditions concrete does not harden as rapidly as during higher temperatures, and the evaporation of moisture from the surface is not so likely to take place to the detriment of the concrete. Under such circumstances the precautions described are unnecessary. As cold weather approaches, arrangements must be made to apply the precautions necessary to protect fresh concrete from freezing, the general practice being to stop work when it is likely temperatures may reach 35 degrees Fahrenheit or lower.

The Association of Ontario Land Surveyors has issued its annual report for the year 1921, incorporating the proceedings of the annual meeting held in Toronto on February 21-23, 1922.

Design of Beam and Girder Formwork

How Forms Should be Fabricated—Economical Methods—Special Ideas Developed from Practical Experience with Concrete Construction

By Wm. F. Lockhardt in "Concrete"

An economical system of beam and girder forms for a building job really starts with the lumber list, on which should be shown clearly the manner in which the lumber is to be used. This will avoid confusion when the carpenter foreman starts the fabrication of forms, and if the lumber list shows, as it should, for just which member each particular piece of lumber has been ordered, very little extra material need be bought, and a great deal of waste can be avoided. Before the lumber list can be made up, however, a thorough knowledge is required of just how the forms are put together, so that as the plans are studied the necessary form details for each individual beam and girder can be clearly pictured mentally.

The methods used for stripping and reposting will also affect the quantity of lumber to be bought, so that it will be most convenient to consider the several phases of the work in turn, touching on the lumber sizes commonly used, with a few notes on safe carrying capacities, posting, stripping, and reshoring, form details and the lumber required and the lumber list itself.

The lumber used must be strong enough to contain and support the mass of semi-liquid concrete that it encloses, and in the case of beam sides and floor panels be stiff enough to hold its lines after it has been made up into forms, without sagging or bulging, or requiring an undue amount of battening or bracing to keep it true. The sizes given here have come to be accepted as standard by most large contractors, and for ordinary building work can be followed to advantage.

Shores and posts, usually 4 in. x 4 in. Rgh. Occasionally 6 in. x 6 in. for special cases of very heavy loads or stories too high for 4 in. x 4 in. posts.

Beam and Girder bottom, 2 in. x . . . in. Dressed 4 Sides to 1¾ in. x (required width) in.

Beam and Girder sides, 1½ in. x . . . in. Dressed 4 Sides to 1¼ in. x (required width) in.

Cleats or battens 1 in. x 4 in., 1¼ in. x 4 in. or 2 in. x 4 in. Rgh.

Ledgers 1¼ in. x 4 in., 1¼ in. x 4 in. or 2 in. x 4 in. Rgh.

Spreaders 3 in. x 4 in. Rgh.

Floor Panels 1 in. x 6 in. Roofers, D 4 S to 7/8 in. x 5½ in. T. & G.

The first step when considering the general layout of the forms, before making up the lumber list, is to figure out the weight to be carried by the forms, and the resultant allowable spacing of the shores. The weight of the concrete is usually taken at about 150 lbs. per cu. ft. The following tables, taken from the "Cambria Handbook," give the safe loads in pounds uniformly distributed, including the weight of the beam itself, for rectangular beams 1 in. thick. The safe load for a beam of any thickness may be found by multiplying the values given in the tables by the thickness of the beam in inches. It is well to bear in mind, however, that these tables are computed for sound structural timber, while much of the lumber entering into form work falls short of this quality. For additional safety, therefore, the values given should be reduced.

Span Ft	Spruce									Short Leaf Yellow Pine								
	Depth of Beam in Inches																	
	4	5	6	7	8	9	10	11	12	4	5	6	7	8	9	10	11	12
1																		
2																		
3																		
4	311	486	700							444								
5	249	389	560	762	996					356	556							
6	207	324	467	635	830	1050	1296			296	463	667	907					
7	178	278	400	544	711	900	1111	1344	1600	254	397	571	778	1016				
8	156	243	350	476	622	788	972	1176	1400	222	347	500	681	889	1125			
9	138	216	311	423	553	700	864	1046	1244	198	309	444	605	790	1000	1235		
10	124	194	280	381	498	630	778	941	1120	178	278	400	544	711	900	1111	1344	1600
11	113	177	255	346	453	573	707	856	1018	162	253	364	495	646	818	1010	1222	1455
12	103	162	233	318	415	525	648	784	933	148	231	333	454	593	750	926	1120	1333
13	96	150	215	293	383	485	598	724	862	137	214	308	419	547	692	855	1034	1231
14	89	139	200	272	356	450	556	672	800	127	198	286	389	508	643	794	960	1143
15	83	130	187	254	332	420	519	627	747	119	185	267	363	474	600	741	896	1067
16	78	122	175	238	311	394	486	588	700	111	174	250	340	444	563	694	840	1000
17	73	114	165	224	293	371	458	554	659	105	163	235	320	418	529	654	791	941
18	69	108	156	212	277	350	432	523	622	99	154	222	302	395	500	617	747	889
19	65	102	147	201	262	332	409	495	589	94	146	211	287	374	474	585	708	842
20		97	140	191	249	315	389	471	560	89	139	200	272	356	450	556	672	800

Where it is necessary to shore up a beam or floor spanning an open shaft be sure that the timbers used are capable of carrying the load. For example, do not use a 3 in. plank to carry a 6 in. x 6 in. shore on a guess, but find out what load the shore is supporting, and then use a timber large enough to carry that load concentrated in the middle of the required span. If practicable from the standpoint of cost, the most satisfactory method is to use continuous shores to a solid bearing below. Sometimes an A-frame of heavy timbers can be utilized to carry the load back to the section of the floor below that borders the shaft.

A very important factor in any posting is the story height. For example, the usual 4 in. x 4 in. shore, if 12 ft. long, will carry 3½ tons safely, but if the length is increased to 16 ft. it will only carry 1¾ tons safely. In high stories it may be advisable to use 6 in. x 6 in. shores, or else spike two 4 x 4's together. Single 4 x 4's over 12 ft. long, and 6 x 6's over 16 ft. long, should be cross-braced or stay-lathed in both directions at vertical intervals of six or seven feet. Where shores are stay-lathed do not use more than three-fourths of safe carrying capacity of the longest section between the stay-lathing, when consulting the tables. It must also be borne in mind that if stay-lathing is required for shores under forms, it is also required for the reshores.

Care should always be taken to cut shores square on the ends and to place them plumb, with a full bearing top and bottom. A post out of plumb will fail much sooner than a shore placed plumb. Spliced shores are an abomination from the standpoint of security, but cannot always be avoided. When it is necessary to splice a shore make sure that the abutting ends are square and that they get a full bearing. The two parts of the shore should line up, the cleats or scabs should be long enough, and properly nailed.

It is always advisable to put cleats on all four sides of the shore. And again finally, see that the shore is set up plumb. While it is bad enough to put a whole shore up out of plumb, is it simply courting disaster to do it with a spliced shore.

The formula of the American Railway Engineering and Maintenance of Way Association for unseasoned short-leaf pine and spruce posts is as follows:

$$L = 1{,}100 \text{ x } (1 - l/60d)$$

in which:

L=Safe load in pounds per square inch
l=Length of post, in inches
d=Least diameter of post, in inches
1,100=Bending extreme fibre safe working stress

The formula is intended for railroad bridges and trestles, and for other structures certain increases are allowed in loading, but as the lumber used for form work is often of a poor grade it is advisable to adhere to the values given by the formula. For convenience a table of values computed for 4 x 4 in. and 6 x 6 in. posts is given herewith, based on this formula.

Spruce or Short-Leaf Yellow Pine

Length in Feet	Least Diameter of Post in Inches 4	6
6	12,800 lbs.	31,600 lbs.
8	10,500 lbs.	29,000 lbs.
10	8,800 lbs.	26,400 lbs.
12	7,000 lbs.	23,800 lbs.
14	5,200 lbs.	21,100 lbs.
16	3,500 lbs.	18,500 lbs.
18	1,700 lbs.	15,800 lbs.
20	No value	13,200 lbs.

Because of the speed with which concrete buildings are ordinarily erected the dead load of the next story is frequently placed on concrete scarcely a week old, when we know that it has only a part of its ultimate strength. This means that to carry the successive stories as they are erected there should always be at least two stories fully reposted (in addition to the shores under the forms) and one additional story partly reposted. This story should have at least half the reshores in place. This is shown in Fig. 1 which is a vertical section through a typical bay of a building. These rules apply to summer or warm weather work carried on at the rate of about a story per week. For winter work or greater speed at least one additional story fully reshored is required, and sometimes more, depending upon the individual job conditions.

A safe stripping schedule is as follows, based on summer conditions:

1. Columns, 24 hours after floor slab is placed.
2. Girders, 60 hours after concreting (third day).
3. Beams, 84 hours after concreting (fourth day).
4. Panels any time after the beams.

The perspective sketch Fig. 2 gives a good idea of the general arrangement of beam and girder forms. The girder forms span between the colums, and are generally supported by blocking up from the top column yoke. The beam forms are carried by the girder forms, generally by spiking a piece of 2 x 4 to the outside of the girder form just below the beam opening. The floor panels are made up with 3 in. x 4 in. spreaders on the back in place of battens. These spreaders rest on a 1¼ in. x 4 in. ledger nailed to the cleats on the outside of the beam form. This shows very plainly in Fig. 3A which shows the carpenters about to lower a floor panel into place. The ledger can be seen very plainly just below the lower ends of the spreaders, which happen in this case to be 2 x 6's. A 3 in. x 4 in. spreader will not carry as great a load as a 2 x 6, but the number of spreaders is usually fixed by the allowable span for the 7/8 boards of which the panel is made, and this is 2 ft. 6 in. or less. Under these conditions, for the usual 4 or 4½ in. slab found in building construction, spanning about six feet between beams, a 3 x 4 spreader is strong enough, and it has the additional advantage that it does not overturn in handling or under load as readily as a 2 x 6.

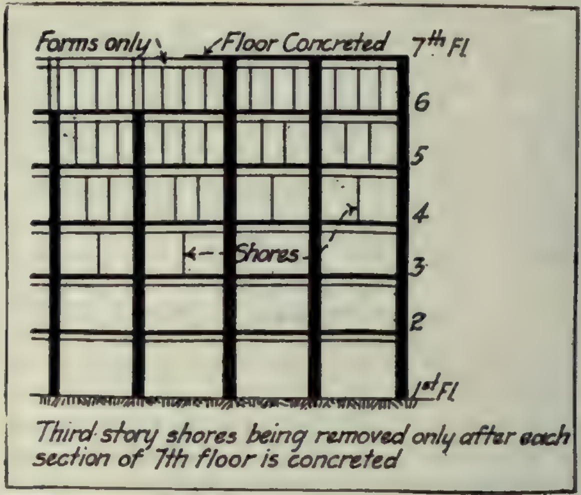

Forms only
Floor Concreted
7th Fl
6
5
4
Shores
3
2
1st Fl
Third story shores being removed only after each section of 7th floor is concreted

Fig. 1—Typical Arrangement of re-shores—concrete is between three and four weeks old before all the re-shores are removed

It should be obvious then, that all parts of the system must be cut and framed to the right sizes to avoid patching out when the floor forms are being assembled in place; it should be equally obvious that if the various members comprising the form system are to be taken down economically, so that they can be used again, without having to cut and saw, proper clearances must be provided where the different members frame into one another. Some simple means must also be provided for closing up the gaps required for the clearances.

The first member to go into place is, of course, the column, where wood column forms are used, because the column forms can then be made to carry the girders. Where metal column forms are used, the trestle or bent previously mentioned will be necessary to carry the girders. Fig. 4 shows a pair of such

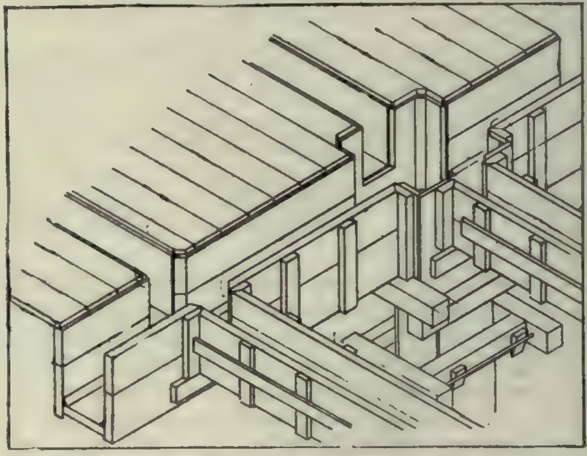


Fig. 2—Perspective of beam and girder assembly at column

bents in position with the girder form roughly set in place on them. The required height for the bent is obtained as follows: Make a rough sketch similar to Fig. 5, putting down first the story height and then the distance from the finished upper floor surface to the under side of the girder forms. Note that this is not the underside of the concrete girder, it is the underside of the girder forms. This dimension is given for example in the drawing as 2 ft. 2-7/8 in. and reference to Fig. 6 will show how this dimension is obtained. If the story height is 14 ft. from finished floor we will have to first subtract the 2 ft. 2-7/8 in. and then make some allowance for wedging under the bent to compensate for uneven spots in the floors. We will allow say 3⅛ in., thus making the height of the bent itself overall 11 ft. 6 in. This will work all right where all, or nearly all, of the girders, are of the same depth. Where the girders are of varying depths it would be inconvenient and expensive to make individual bents for each particular case, so that it is usual to make the bents low enough to take the deepest girders that are typical, and provide a shelf as shown in Fig. 5 upon which to wedge and block the shallow girders to the right elevation.

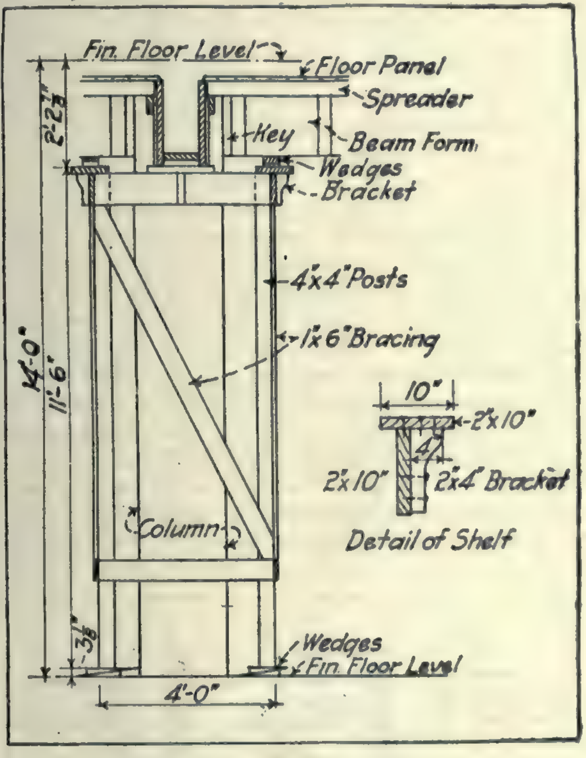


Fig. 5

From this point it will be an advantage to consider the form details and the lumber list together. The first step in making up the lumber list for the floor forms will be to set down the lumber required for the girders. Refer again to Fig. 6.

At "a" is shown the girder section as it will probably appear on the blue-print. Note that the depth of the girder includes the thickness of the floor slab, in this case 4 in. This is the usual method of giving beam and girder dimensions. At "b" we have the superintendent's sketch showing how he intends to build the form. The width of the girder is given as 10 in. For the girder bottom he will order a 2 in. x 10 in. plank "Dressed 2 Sides" to 1¾ in. x 10 in. The edges will in this case be left rough, as to dress them down would take ¼ in. from the width of the plank, with nothing gained by so doing, as the joint between the beam bottom and the girder side is covered with a bevelled molding called a skewback. The skewback is generally ⅞ in. for beams and girders. Larger skewbacks than ⅞ in. are not often used in building work.

For the sides of the girder form the superintendent has noted three pieces of 1½ in. x 8 in. D 4 S to 1¼ x 7¾ in. These three pieces add up to 23¼ in. while the drawing shows that only 21⅞ in. is required from the bottom of the floor panel to the underside of the beam bottom, but by having the sides project slightly below the bottom piece the shores bear up against the lower edge of the sides instead of against the bottom plank. This makes the form much less likely to sag between the shores and gives better lines. It is important that all beam and girder-side lumber be dressed to exactly the same thickness (1¼ in. or 1¾ in.) as it will be impossible to get a good looking job of concrete if some of the planks in the form are finished in ⅜ in. thick and others 1⅛ in. or 1¼ in. A note should always be made on the order for the lumber for beams and girders that all the material of a given thickness must be dressed uniformly to that dimension.

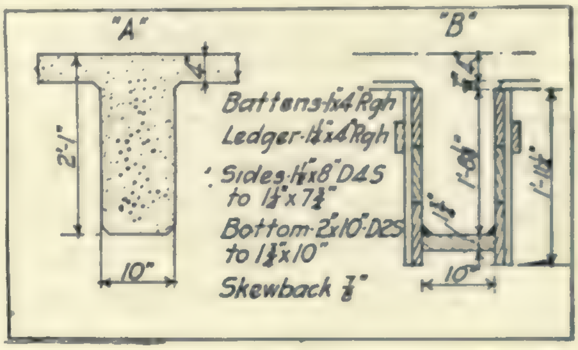


Fig. 6

The length of the girder form will be somewhat less than the clear span between the concrete columns. In ordering the lumber it must be borne in mind that the girder will first be used between the colums in the basement or first story. Here the columns will have the greatest diameter and the girder form will consequently be shortest. If the drawing gives the length of the bay as say 20 ft. centre to centre of columns, with the columns assumed as 2 ft. in diameter, the clear span between the columns will be 18 ft. In discussing the length of a beam or girder form it may be well to mention at this point that the "length" of the form will refer to the length of the bottom plank. It is usual to make the sides of the form about 1½ in. shorter at each end than the bottom, to facilitate stripping. When the concrete is poured

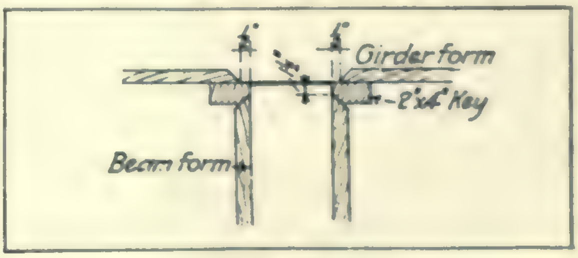


Fig. 7

the pressure will force all the abutting form surfaces tightly together. If the sides are made full length, the pressure of the column forms against the ends of the girder form will make it next to impossible to get the form down. If the sides are made an inch or more short at each end a removable "key" piece may be inserted as shown in Fig. 7, which shows the condition at the junction of column and girder forms, or beam and girder forms, the details being similar in each case. The key, being bevelled, can usually be removed without difficulty, but if it sticks, it can be chopped out without injury to the main form, thus providing the clearance required. The bottom form may be made practically full length, as clearance is provided as soon as one end is pried down.

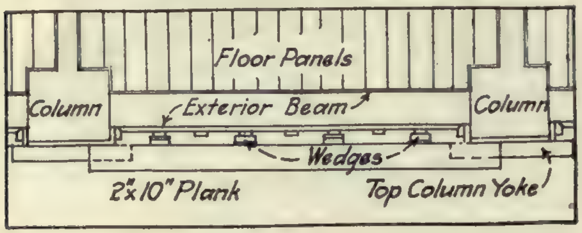


Fig. 8

If metal column forms are to be used, the girder form may be made the full 18 ft. long, lacking about ¼ in. for the thickness of the metal in the column molds, which will be nailed to the ends of the girder forms.

When a wood column form is used, the length is figured in exactly the same way, taking into account, however, the thickness of the wood in the column forms, these being generally built of ⅞ in. lumber for interior columns. For the same case as we have assumed before the length of the girder bottom would be 18 ft. less two thicknesses of ⅞ in. material, or 17 ft. 10¼ in. The sides of course will be 3 in. shorter than the bottom, to allow the 1½ in. at each end for keying, thus making the sides 17 ft. 7¼ in. long.

The ends of the girder sides are cut on a 45 degree bevel as shown in Fig. 7. This drawing also shows the opening in column capital or girder, as the case may be, which is cut on a bevel the other way. The opening in the column is made 1 in. greater than the width and ½ in. greater than the depth of the beam. When the form is stripped this will show up as a narrow raised molding ½ in. wide around the end of the girder which is of value in making less conspicuous minor irregularities that may occur in fitting the members together. Where wood column forms are used it is advisable to set the top column yoke at such an elevation that it will carry the girder at the proper height.

As the columns reduce in diameter from story to story it will be necessary to lengthen out the girder forms. This can easily be done by lightly nailing in place a piece of beam side material of the right width each time the column reduces. Or if the patch is fastened on with a splice on the back, it can be removed each time the column reduces and a new piece of the required total width substituted. This will mean only one patch at the end of the girder instead of several.

The beam forms are made up in exactly the same manner as the girder forms. The depth of the beam having been taken from the plans a sketch is made up to show the section and on this section are marked the sizes of the various pieces of lumber required to make up the form. It will always cost slightly more to make up a form of several pieces of 6 in. or 8 in. lumber than a lesser number of 10 in. or 12 in. pieces, but the slight difference in labor cost is more than offset by the difference in the cost of material, the 10 in. and 12 in. lumber being much more expensive, and therefore to be avoided where possible.

Cleats or battens are required on beams and girders to hold together the various pieces of lumber of which the form is built. These battens are 1 in. x 4 in. or 1¼ in. x 4 in. rough. Spacing is usually 2 ft. to 2 ft. 6 in. centre to centre. The lumber list for each member should include these miscellaneous items:

Number of feet of batten material required; number of feet of ledger; number of feet of key lumber, and skewback footage. This helps to insure that every item has been given attention.

Exterior beams present an additional problem in bracing, as there is no panel and spreader construction on the building line side to keep the form from opening up wider at the top than it is at the bottom. Two methods are generally used to keep the outside of the beam in line. The first is to put a large number of shores under the beam and put spur braces at an angle of 45 degrees between the "T" head on the shore and the side of the beam. While this is the method most commonly used it has several disadvantages. It requires an unnecessarily large number of shores, for one thing, and it also requires that the head of the shore be two or three times as long as would otherwise be necessary. There is the labor of cutting and nailing in place a large number of the small spur braces, and the final disadvantage that the form will often spring anyway, and there is then no practicable method of getting it back into line. This has caused some contractors to adopt the method shown in Fig. 8. A 2 in. x 8 in. or 2 in. x 10 in. plank, depending on the span between columns, is spiked flat to the top yoke of the columns, and wedges are then driven between the plank and the beamside as often as may be necessary to hold the beamside in line. Then, if the form does show signs of working out of line because of spring in the plank, it is a simple matter to drive down such wedges as may be necessary to correct the trouble, while the pouring is going on. By this method no more shores are required than for an interior girder, and the "T" head need be only long enough to give the girder a bearing. This makes the shores much easier to handle. As cutting is rarely required scaffold plank can be used for this bracing to good advantage without extra expense for special material.

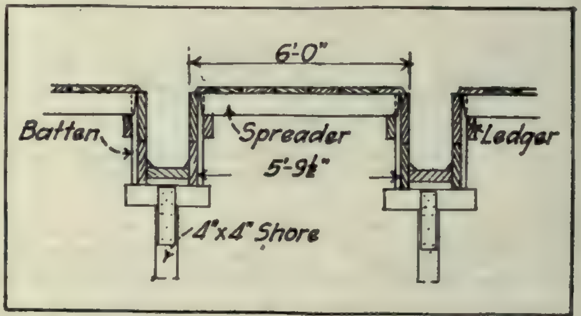


Fig. 9

As shown in Fig. 3 the beam forms have a 1¼ x 4 or 2 x 4 ledger spiked to the side cleats. This ledger carries the spreaders on which the floor panel is made up. Fig. 9 gives a cross section through two beams, which shows the construction. The spreaders are 3 in. x 4 in. rough, sized at the ends to 3¾ in. or 3½ in. This is best done by making a saw cut about 6 in. long at the required length, but before they have been made up into panels. This is just the same as sizing the underside of a floor beam in ordinary brick or frame construction to keep the floor level.

The length of the spreader will be the measurement between the beam forms. As the clear opening between the beams in the drawing is given at 6 ft., the back to back distance between the beam sides would be 5 ft. 9½ in., which would then be the length of the spreaders. The ends of the spreaders should be slightly beveled as shown.

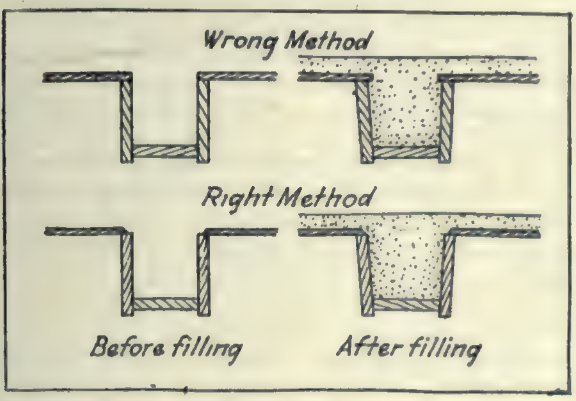


Fig. 10

The floor panels, too, will have to be patched out each roofers. The width of the panel should be 1 in. less than the clear span between beams, this allowing ½ in. play all around. The edges of the floor panels should be chamfered or beveled as shown in Figs. 9 and 10. Beams and girder forms will sometimes spread at the top when being filled. If this occurs, and the panel is not made with the ½ in. clearance recommended, and the edges beveled, it will bind as shown in Fig. 10 and be damaged in stripping.

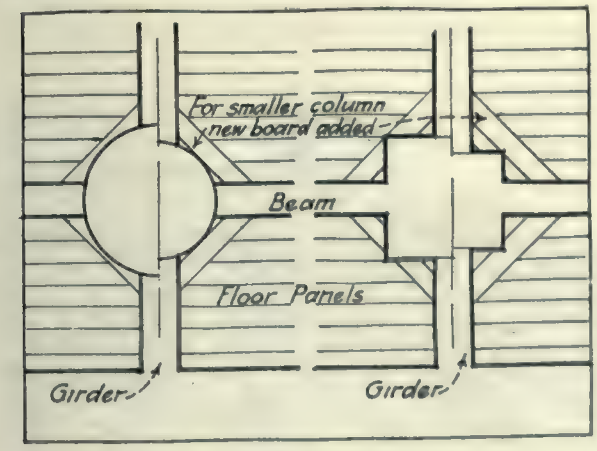


Fig. 11

The floor panels, too, will have to be patched out each time the columns reduce in diameter. This may be done by simply adding in a little filler piece each time, which is rarely satisfactory in appearance, or the following method may be used. As shown in Fig. 11, the corners of the panels adjacent to the column are made with the boards running at an angle of 45 degrees. When the column size reduces, the short boards in this corner section are taken off and new boards substituted. When a circular column is used the same method is followed, and after the necessary new boards have been put in the panel a circle of the required radius is scribed on the panels and the cut made with a compass saw. The method of building the floor panels and patching them out always leaves a clean, neat corner at the column. When sheet metal column forms are used the metal form is usually run up first to the under side of the girders, and the space between the girders and beams filled out with four pieces of metal of the proper size, curved to the same radius as the column. These pieces usually lap the column forms and are bolted to it.

Occasionally a special case will arise in long span beam and girder construction in which it would be dangerous to remove all the shores from under a beam and leave it entirely unsupported during the operation of stripping. Two methods are shown in Figs. 12 and 13, which have been very successful under these conditions.

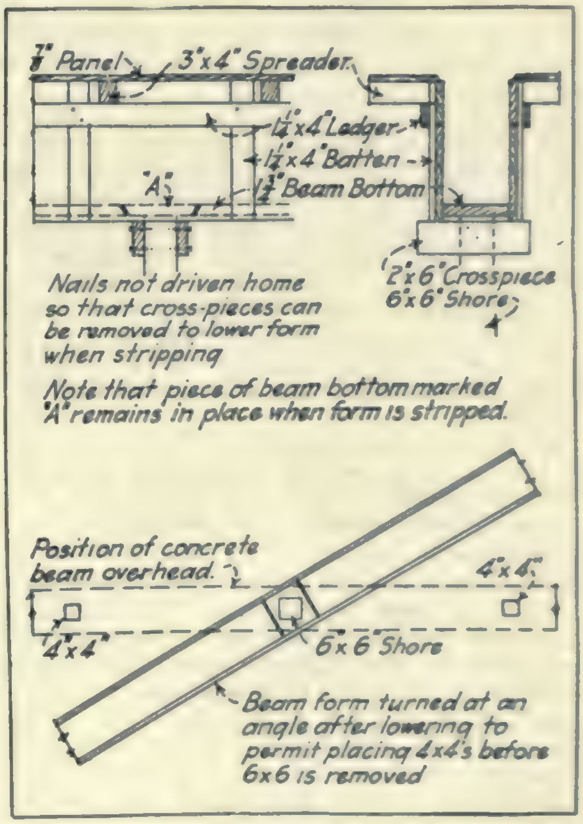

⅞" Panel
3"x4" Spreader
1¼"x4" Ledger
1½"x4" Batten
1½" Beam Bottom
"A"
Nails not driven home so that cross-pieces can be removed to lower form when stripping
2"x6" Crosspiece
6"x6" Shore
Note that piece of beam bottom marked "A" remains in place when form is stripped.
Position of concrete beam overhead.
4"x4"
4"x4"
6x6" Shore
Beam form turned at an angle after lowering to permit placing 4x4's before 6x6 is removed

Fig. 12

The method shown in Fig. 12 is suitable for beams somewhat in excess of the usual spans, say 30 or 35 ft. For longer spans the method shown in Fig. 13 should be used. For the method shown in Fig. 12 the beam form is made up practically unchanged, except for the square removable section of the beam bottom located in the center of the span. This section should be the full width of the beam bottom, with the ends beveled as shown in the drawing, and lightly nailed in place when the form is set up. A "permanent" shore is placed under it. By nailing 2 x 6 cross pieces to the 6 x 6, as shown, it can be made to carry the form during the pouring operation. When ready to strip, all the 4 x 4 shores are taken down, the 2 x 6 cross pieces removed from the permanent shore, and the beam lowered to the ground. After it has reached the ground the beam can be skewed around at an angle to the axis of the beam, to permit reposting with the 4 x 4's. When the reshores are all in place the 6 x 6 may be taken down, and the beam form carried away.

The second method is suitable for spans longer than those mentioned above, and should be used wherever it is thought necessary or advisable to leave one or more shores permanently in place under the beam. The beam form is made in halves, the bottom piece in each half being 4 ft. shorter at the joint end than the sides. The two parts are spliced together on the floor and an 8 ft. section of bottom lightly nailed in place. A 6 x 6 permanent shore is then placed near each end of the 8 ft. removable bottom section, in addition to the regular 4 x 4's. To strip, the 4 x 4 shores are taken down and the splice pieces taken off, allowing the form to be lowered in two parts, the 8 ft. bottom section remaining in place to avoid the slight deflection that might occur by allowing the green beam to go unsupported for even a short time.

Any kind of a lumber list that gives all the information needed by the superintendent, purchasing agent, and carpenter foreman is a good one, but it is very rarely that a man makes up such a list of his own accord. Very often the man who makes up the lumber list from the drawings is not the man who builds the job; very often he is not even within reach when information is wanted. The result is that the superintendent and carpenter foreman have to guess what half the items on the list were intended for. One man will order 1 x 4 stuff for battens and 1¼ x 4 for ledgers; another will use 1¼ x 4 for battens and possibly the same material or 2 x 4's for ledgers. If the lumber list is not self-explanatory, more of one size lumber will be ordered before the job is over and a lot of other material will be left over at the end of the work.

The simplest method is to go up through the plans, starting with the footings. Tackle next columns, column bracing, yokes, etc. Then beams and girders, and lastly floor panels. After these have been disposed of, special items like pent-houses, stairs, ornamentation, etc., may be picked up. Take the plans systematically, item by item, and for each kind of construction, such as a footing, pedestal, column, beam, girder, etc., make a sketch at the top of the page to show the arrangement of parts, spacing of yokes, battens, spreaders, etc., and any other information that may be necessary to enable the "next man" to tell how you intended to build the forms. Then, if he doesn't want to follow your method, he will at least know where his method differs from yours and how much extra material he will have to order to build the forms his own way. Every man has his own way of allowing for waste and cutting, but if the foreman knows just where each stick of lumber is to go, there need be very little extra material ordered at the start. And every one who has been on a concrete job knows that whether you have worlds of extra material at the start, or none at all, it will be necessary to order just as much during the course of the work. Moral: Make your list so that you need order just what will actually be needed to get the full set of forms built; if you guess and add extra material here and there for safety, you will probably never know where it went, and you'll have to buy more just the same.

Soapstone Found in Ontario

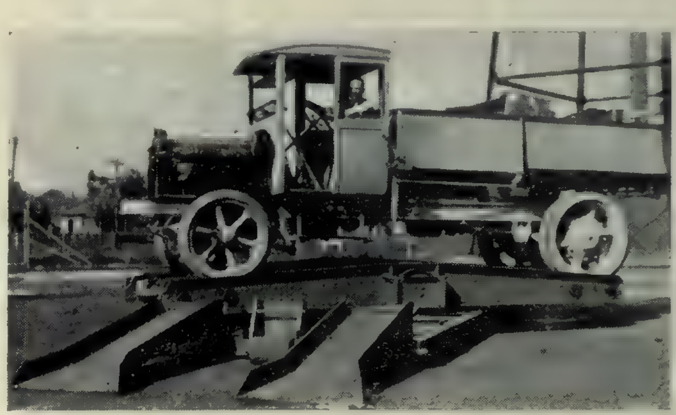
An interesting and extensive deposit of so-called soapstone occurs near Dryden, Ontario, close to Wabigoon Lake, and only 500 yards from the Canadian Pacific Railway. This has been examined and reported on by Mr. H. S. Spence of the Canadian Department of Mines.

Outside of a small amount of stripping, no development work has as yet been conducted on the property according to "Stone." There is very little overburden, however and the outcrops are sufficient to show the existence of a large body of soapstone. The stone may be termed soapstone though beyond being soft enough to be cut readily with an ordinary saw it possesses few of the outward characteristics of what is usually classed as soapstone. It yields a greenish-gray powder that possesses little slip, and the stone is not greasy to the touch as is talc.

Various tests have been made of the stone. Its crushing strength ranges between 10,000 and 12,000 pounds per square inch. Its absorption is only 0.12 per cent. It showed greater resistance to concentrated hydraulic acid that Virginia soapstone, and its fusion temperature was 1,400 degrees C., as against 1,350 degrees C. for Virginia soapstone. Chemical analysis shows that it is very similar to the latter stone, save that it has more silica and less carbon dioxide. There are two well-filled beds, separated by about 100 feet of hard grit rock. One has a proven length of over 500 feet, with a width of 35 feet. The other seems even more extensive from the outcroppings, but has not been thoroughly tested.

Automatic Truck Turntable

Champion Engineering Company, Kenton, Ohio, are distributing a folder describing their automatic truck turntable, as illustrated below. The illustration shows the turntable in action. It is operated by the rear wheels of the motor truck and will handle all sizes from a Ford delivery to a 5-ton machine. It is claimed that the operation of turning occupies only 20 seconds. Another advantage is that only half the roadway is occupied. This is an all-steel equipment, simple in design, but practically indestructible. It is designed to help the contractor to move more tons of material per day without increasing his equipment; the manufacturers quote a case where a road builder made an extra profit of $63.60 per day and a haulage contractor on another job saved $33.00 per day. The turntable is on rollers and may easily be moved along the road as required.



Building Activity and Rents

General Conditions in the Construction Industry—Survey of Rent Values in the Dominion

The Royal Bank of Canada in its recent monthly review of business and financial conditions has the following to say regarding the building situation and the relation of rental values thereto:

The various branches of the building trades are closely dependent, as are most other branches of industrial activity, upon general business conditions. The trade depression through which we have been passing has made serious inroads upon progress in this field, as elsewhere. There is, however, one important difference; building is one of those industries in which the natural movement of the trade cycle was not greatly interfered with by the war. It is generally conceded that the down-swing of the business cycle had made its beginning just prior to the war, but that the sudden demand for goods and services, induced by war conditions, postponed the depression in those industries which were concerned directly with the production of necessities, and with the promotion of military activities. The building trades are not included in this category, except indirectly and in a limited way.

At the end of 1912, building construction throughout Canada was at its height. In 1913, however, a decline in building took place, and this continued until about the beginning of 1916. The level which was reached at that time was maintained for nearly three years. Soon after the signing of the armistice, there was slightly increased activity in building construction, which continued until the effects of the general trade depression began to be felt in the spring of 1920. As a consequence of this long period of comparative inactivity in construction, there has been a serious shortage of buildings, more especially of dwelling houses, throughout the country.

Stage Set for Extensive Operations

The stage, then, has been set for extensive building construction, but certain factors have operated to prevent the carrying out of such a program. Chief among these were the high costs of labor and of materials. Labor costs have fallen considerably in certain districts. Taking the country as a whole, building costs also are still tending slightly downward. The wholesale price index number of 48 building materials, according to figures compiled by the Department of Labor, stood at 253.4 in April, as against 254.3 in March. This is a very substantial decline from the figure for April 1920, which was 386.6, but it is still very much higher than the April 1913 figure, viz. 141.6.

During the first five months of the present year, the number of building construction contracts awarded showed a gradual and substantial increase. The aggregate value of these contracts, during the period named, was $96,831,600, in comparison with $85,326-700 for the corresponding period last year. The highest monthly record since 1914, with one exception, was made in the month of May, when building contracts amounted to $34,827,300.

Rents Have not Fallen

A survey of building and rent statistics throughout the Dominion indicates a wide variation of conditions in the different districts. Rents, on the average have as yet shown very little inclination to fall. In British Columbia, the housing situation is quite satisfactory. There is neither a shortage of houses nor is there any considerable surplus. A large number of new residences have been built during the last two years. Retail merchants report that the tendency of business rents is likely to be downward in the near future. In the Middle West, construction costs are still too high to warrant building residences as an investment. Rents have declined somewhat in those centres that have been slower to recover from the depressed condition of business. In Ontario and Quebec, the larger cities report substantial building programs, both for industrial and for residential purposes. The high cost of building, in addition to high taxes and high rates on mortgage loans, has discouraged the building of houses for rent. Those houses which are being built are for personal use or for resale to owners. Rents in this area show a tendency to decline in the larger centres. In the towns and rural districts, however, rentals remain firm, and in some cases they have shown a slight increase. In the larger cities, there is slightly more available space than was the case last year. Little change has occurred in rents in the Maritime Provinces. Building there has been greatly restricted on account of the high cost of materials and also of labor.

In general, then, rents have not fallen materially nor are there definite prospects for any substantial reduction in the immediate future. The decline in salaries and incomes, lower building costs, increased construction, and the additional space available therefrom, must, however, make for lower rentals eventually.

Dwight P. Robinson & Company Adopts Group Life Insurance

Dwight P. Robinson & Company, Engineers and Constructors with main offices in New York City and branch offices in Chicago, Los Angeles, Montreal, Youngstown, Dallas and Rio de Janeiro, Brazil, has recently entered into a contract with the Metropolitan Life Insurance Company by which life insurance policies are provided without expense to individuals for all members of its organization reporting to the central office under a group insurance plan. This insurance is without cost to the employees and its benefits are in addition to those provided by law under the various workmen's compensation acts.

All employees included in the plan are insured regardless of their age and condition of health and no medical or physical examination is required. The amount of insurance is increased $100 for each additional year of continuous employment and this plan of regular increase is thus a recognition of length of service. Each employee has the privilege of naming his or her beneficiary which may be changed if necessary, and individual policies are issued to each insured employee as evidence of the coverage. Not only life insurance but provision for total and permanent disability before the age of sixty is included in the contract. In case of disability the amount of insurance stated on the certificate is paid to the insured in monthly or annual instalments. If death occurs during this period of disability, the remaining amount is paid to the beneficiary.

The Metropolitan Life Insurance Company maintains a very comprehensive group insurance plan.

which includes the furnishing of professional graduate nurses to the homes of employees covered under group policies in case of illness. The nurses' duties are to assist in carrying out the instructions of the physicans in charge, advising members of the household in the proper care of patients and visiting the homes as often as may be needed. The Insurance Company also maintains a complete course of literature and lectures dealing with matters of health, hygiene and disease prevention.

Dwight P. Robinson & Company is one of a score or more of large commercial organizations which within the last few years have come to recognize group life insurance as a valuable business asset.

The Functions of a Trade Association

How Such an Organization can Render Public Service, Increase the Market of the Material it Represents and Open up New Lines of Industry—The Portland Cement Association as an Example

By H. COLIN CAMPBELL
Portland Cement Association

Before National Industrial Advertising Conference

Probably no one will ever complete a list of all ways and means to expand markets for raw materials. Certainly a dominating method is to know as much as seems possible about the adaptability of such materials. This known, it is evident that one can then direct his attention toward seeing that they are used so that the best results possible will be realized. The ways of using any given raw material may be numerous. Steel intended for horseshoes does not pass through the same processes as steel convetrted into watch springs.

What is a Raw Material

Many people if asked to give the dictionary definition of raw materials might be unable to do so. They would, however, be able to make clear their understanding of the term by mentioning wool, cotton, iron, clay, and a great variety of other materials which in their basic form are of little or no use to mankind. These materials acquire real value to mankind only after having been put through one or several manufacturing processes which convert them into what is commonly called finished products.

To the man who needs a suit of clothes, its equivalent weight of unspun wool or unwoven yarn is worthless. The man who needs mortar to lay cut stone, brick, or concrete block sees nothing that will satisfy his need in the mountain of rock, which after being put through a multiplicity of processes becomes portland cement. Yet the mountain of rock has a distinct value because a market has been made for it through the discovery that when put through certain processes it will become one of the strongest binding or bonding materials known.

However,. portland cement even after having reached the dignity of a manufactured product is still a raw material until those who are to use it know and apply the ways and means necessary to most efficient effective use. Likewise,. a suit of clothes remains raw materials so far as the individual purchaser is concerned if it is so small that he cannot get into it or due to any other fault he cannot obtain in satisfaction or service the equivalent of its price

Interdependence of Industries

I believe the unqualified statement may be made that no manufacturing concern and no producer of raw material, as first defined, can separate or isolate himself from the many and varied enterprises going on about him if he expects success. A careful study will disclose a load which shows his relation to, and interdependence with many other enterprises, seemingly remote from his common place individual interests, and of vital concern to the ultimate and continued success of his business.

If I happen to refer frequently to, or dwell at some length upon the manner in which the Portland Cement Association endeavors to expand the logical market for cement, I hope you will accept as the reason the fact that in our methods are found as striking examples as can be to illustrate ways and means of expanding markets.

The discovery that a mountain of raw materials could be converted into a product known as portland cement is in itself an illustration of the expansion of markets. There are not far from 100 distinct operations that must be performed before a sack of cement can be turned over to a prospective purchaser as a product ready for use. Each one of these operations requires some related operation, manipulation, or process, the use of some device, the carrying out of some method that calls for machinery, fuel to drive it, laboratory work of a high order to determine quality. In other words, the seemingly simple process of tearing down a mountain and putting it through a sieve makes, sustains, and expands markets for a variety of other raw materials in direct ratio to the demand developed for the finished product.

If cement mills were to be shut down because there were no longer any demand for their output, there would immediately follow a reduced market for iron and steel, a great variety of tools, machines, dynamite, and other things necessary to equip and operate such plants. As a result there would naturally follow the loss of a field for the sales efforts formerly directed toward securing purchasers for the product normal to the abandoned industry. In other words, the far reaching effect of continuance or suspension of cement manufacture would soon become evident.

Creation of New Markets

The development of the automotive industry has caused a great deal of latent talent and inventive genius to become productive, which has created wealth by expanding established markets not only for well known materials but has created markets for new ones. An automobile requires grades of steel and other products that were unknown or not in special demand before the motor vehicles became established. Inventive and research genius were directed toward making the discoveries that would produce the necessary steel with the required chemical and physical properties. As a result raw or basic materials that before had never entered into commerce, found a market had been established for them. A luxurious car requires special upholstery, many trappings and trimmings that add to utility as well as convenience. All of these are regarded as necessities to the car owner and for that reason are recognized articles of commerce. The demand for them, created by taste, pride, avarice, or what not, has been reflected in new demands on the textile, steel, and related industries, which you can readily enumerate for yourself.

The Portland Cement Association is purely a voluntary organization. In popular conception it is classed with other organizations referred to as "trade associations."

The underlying idea however, of the Portland Cement Association is expressed in that often used, much abused, and sometimes meaningless word "service." Our headquarters in Chicago is the executive center for all of the activities in which we engage. Each district office is a service organization like our headquarters office but on a smaller scale, although sufficiently complete and comprehensive to quickly and efficiently serve the territory of which it is local headquarters. Depending upon the number and intensity of various campaigns we may be engaged in, our staff averages around 300. Most of our men are technically trained—usually civil engineers. Also most of them are, or soon become peculiar engineers in that they are able to keep their technical or professional training from interfering with the ability to put their ideas and aid in such form as to make popular consumption easy. They are trained in promotion. They are salesmen who have nothing to sell but an idea, which is "Concrete for Permanence."

Research Laboratory

Probably the backbone of our whole educational scheme is in our Structural Materials Research Laboratory, operated jointly and in co-operation with the Lewis Institute, Chicago. Here a large corps of practically trained technical men are engaging in research work on the various uses of cement and concrete. Since 1916 considerably more than 100,000 chemical and physical tests have been made in this laboratory solely to determine how best to use concrete, as well as how not to use it—in other words, discovering and establishing the possibilities of cement as expressed in concrete construction.

In spite of the fact that the Portland Cement Association is twenty years old, and during all that time has been attempting to further knowledge on the use of concrete, it may startle you to know that within the last seven or eight years we have learned more about how, and how not to use it than was known in all the years before.

The evident advantages of concrete construction were early recognized and tempted many to write their own specifications, so to speak, for using the material, with the natural result that cement—the principal ingredient—was discredited because of faulty use. It was evident, therefore, that practical guidance, based on scientific knowledge and established facts, was necessary to prevent abuse of a worthy material.

Until within comparatively recent times, nothing was known as to the effect which clay and other impurities as an admixture with the sand and pebbles used in concrete might have on the strength of a finished structure. Studies have been made in our laboratory on the effect size and grading of aggregates have on concrete, the effect of using different types of aggregates, the effect of various impurities in aggregates, the effect of various powdered admixtures in portland cement such as coloring matter and hydrated lime used for a definite purpose, the effect of impure mixing water such as impurities caused by industrial waste, etc.

Saving Money by Change in Methods

At first glance these studies might seem as having but remote connection to expansion of the market for cement. However, as an example, our studies on the effect of size and grading of aggregates as related to a concrete mixture have been most favorably illustrated on a piece of concrete highway construction now in process in the Imperial Valley, Calif. At the quarry where aggregates were being obtained for the concrete used in this pavement, methods employed in screening the crushed stone for the concrete mixture caused a waste of 35 per cent of the materials taken from the quarry. One of our field engineers, who was interested in watching the progress of this work, suggested that a change in the methods of screening materials, based on our laboratory tests, would considerably reduce this waste of materials. His suggestion was adopted with the result that a waste of only 15 per cent followed changed methods in screening. What this meant to this particular job, or rather to the taxpayers of the community who are bearing the cost of the work, was that instead of costing $1.00 a ton to prepare, the stone cost 42 cents, or expressed in dollars, $30,000 were saved, which made it possible for the community to build an extra mile of concrete road. This of course is not the only example of its kind. It is, however, the most recent one of such magnitude.

Technical men do not need this example to prove the importance of technical studies as a basis for such practical aid as this to the uninitiated user of concrete or any other material. I believe I have already said that there is an unavoidable interdependence in all business life and there is no desire to conceal the fact that although the application of our laboratory studies to this particular piece of highway construction saved to the taxpayers $30,000, or put it the other way, gave them an extra mile of concrete road, it at the same time made a market for 3,500 barrels more of cement.

Among the various classes of educational work that we carry on are lectures before agricultural colleges, farmers' institutes, engineering colleges and universities, co-operation with county agents, architects, engineers, contractors, building commissioners, having to do with revision or writing of building codes, vocational schools in which we endeavor to establish simple courses in manual training through the use of concrete, etc.

Service to the Public

We have assisted a great many aspiring men to go in the contracting field, specializing in concrete construction. We have promoted through educational work a higher standard for building codes in many cities and are continuing this work everywhere that our aid is asked. The result of this is certain to be expressed ultimately in economies of construction, more highly fire resistive construction.

consequent reduction of national fire losses—a distinct service to the public, an establishment of a certain amount of resultant good will, and an extension of the market for cement.

We distributed several million educational-informational booklets last year. These discussed the advantages of the use of cement in the form of concrete construction in many fields. Concrete on the Dairy Farm, Concrete on the Hog Farm, Concrete Around the Home, are typical titles of these booklets. We have booklets or series of booklets devoted strictly to concrete construction in specialized structural fields. These booklets are continually revised by incorporation of the latest information disclosed by study, research or experience and are in that way kept up to date.

We use miles of motion picture films. We have a film showing the numerous processes involved in the manufacture of portland cement. It does not require a high order of intelligence after having seen this film to realize a sack of cement represents the combined expense or cost of many operations, one of which, for example, is the use of 50 pounds of coal.

Of course, we have no connection with cement dealers other than placing at their disposal motion picture films or other educational matter which they may wish to use in the immediate furtherance of cement sales. Occupying this unique position with relation to the industry, we can devote our whole time and such talent as we have to further expansion or extension of our educational methods and to the development of new ones.

Link-Belt Portable Belt Conveyor

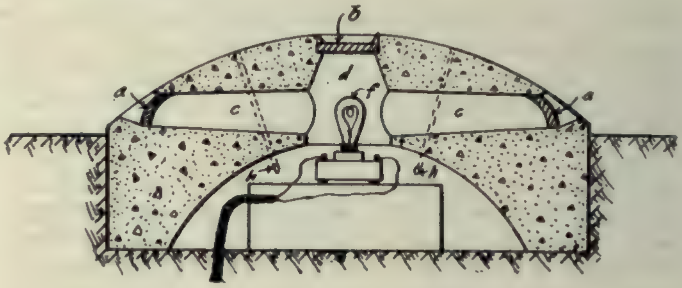
The cut herewith shows the new re-designed Link-Belt portable belt conveyor manufactured by the Canadian Link-Belt Co., Toronto. In offering this new design, the Link-Belt Company have endeavored to standardize on a few sizes which will meet practically all requirements and at the same time simplify the machine. They now offer three lengths of conveyor, namely, 21 feet, 26 feet and 31 feet, and can supply the 21 foot machine with the frame supported underneath so that it can be operated where headroom is low.

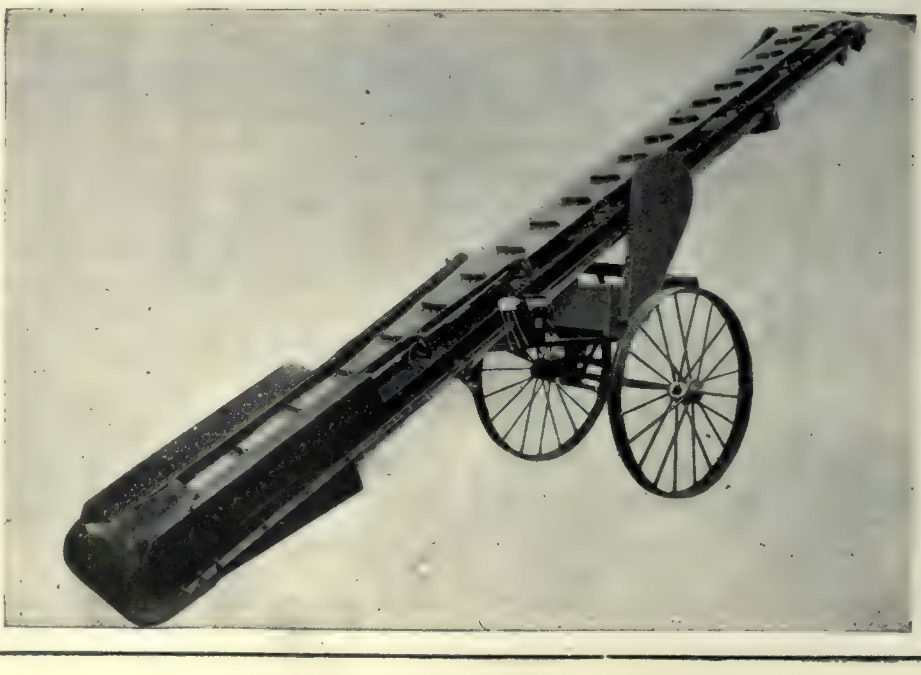
The carrying medium is a belt with metal cleats if required to prevent the material from flowing back. The idlers are their standard Uniroll troughing type, with cast iron bell ends. These idlers run in ball bearings to insure minimum friction and eliminate trouble from mis-alignment. Particular attention has been paid to the hopper and skirt board construction to prevent tearing of the belt and to insure efficient loading. All the machinery is entirely enclosed and all bearings self-aligning, making the equipment quite fool-proof.

A New Traffic Light

This traffic light is constructed of indestructible material and embodies an illuminating device, built in such a way that it cannot be damaged or broken.

It consists of a dome-shaped reinforced concrete body containing a chamber in which is arranged the necessary electric light connections. From the centre of the body there are a number of bores (c) extending radially, the outer ends of which are closed with colored lenses (a) placed diagonally therein. A relatively larger lens (b) is also placed within a vertical hole (d). Metal linings assist to a great extent the reflection of the light rays. An ordinary electric light bulb (f) serves to supply the necessary lighting. Air vents (h) are also provided for the purpose of ventilating the interior of the dome. This traffic light device is patented in Canada.





The redesigned Link-Belt portable belt conveyor for handling materials of all kinds.

Detailing Cut Stone Lintels and Arches

Specifications Issued by the Indiana Limestone Quarrymen's Association—Aid in Providing More Uniform Work

Accepted practice in the mode of detailing various features of cut stone work are set forth in the appendices accompanying the Standard Specifications issued by the Service Department of the Indiana Limestone Quarrymen's Association. These specifications are intended to bring about a clearer understanding between the architectural profession and the cut-stone industry, and to aid in providing more uniform work. Some details follow:

Jack-Arches:—Jack-Arches, particularly when they occur in the facing of enclosure walls and except when of very wide span and depth, should generally be cut in a single piece and be false jointed. The question arises, as to why cut false joints into a perfectly sound piece of stone capable of acting as a beam and supporting the load over opening. This, of course, is a question of design and it is assumed that jointing would not be resorted to if it were not a necessary or desirable feature of the design.

Lintels:—The depth of bearing for support of lintels at jambs is important, and should preferably be as little as both structural and design considerations will permit. An ordinary lintel with from 3-inches to 5-inch bearing is preferable, in most instances, to one with greater extension beyond face of jambs, and 4-inch bearing is a good average. Where structural steel is used to support either stone facing or entire wall, over long, self-supporting stone lintels, the placing of such steel should be arranged with ample clearance over top of stone lintel, both on account of the inherent minor irregularities in structural steel work and to avoid placing of load on stone lintel when steel is deflected under its full loading after the wall work above has been built.

Mullions:—Thin mullions of moulded piers should also be shown as a single length, with false jointing to conform with the coursing of wall ashlar or trim around openings when this is considered desirable. They often look much better, particularly if slender; and, when carved with sculptural detail, if left solid and without joints. Such mullions should be dowelled into sill and head with non-corrusive metal dowels, brass, bronze, or thoroughly galvanized iron.

Narrow piers are also frequently cut into a single section and false joints. Even when rusticated, narrow piers may often, to advantage, be cut in a single piece. When it does not affect the design, such items of detailing should be made optional.

Transom Bars:—Transom bars should, except in the cheapest grade of work, be cut with seats for mullions and this should be clearly indicated on details and where jointing is necessary they should be jointed over centre of mullions.

Colonnade Lintels:—For entablatures, cornices or belt courses spanning either an open colonnade, or an engaged column, or pilaster-pier treatment of a facade, it is advisable whenever practical to make the architrave, or lintel member of the entablature, or belt course of a single length, spanning the space between supports.

Where the pilaster treatment is very flat, there is not the same objection to jointing as with piers, engaged columns or free standing columns and the architrave may be jointed, preferably making same in three sections.

Where the lintel is of one piece, particularly with a free standing order, it should be detailed so that the weight will not rest on the outer edge of column caps; this can be accomplished by setting the lintel stone on lead buttons or sheet lead pads that are placed back within line of the column shaft, pointing up around the edges only with mortar after the entire work is completed.

Whenever it is necessary to hang the lintel or to support same in center, a questionable practice, only lewis anchors should be used and the top of stone should be kept clear of the steel, except at points of bearing, where lead pads should be used.

Where a self-supporting colonnade lintel forms the lower members of an entablature or pediment, the weight of all work above the lintel for all usual column spacings should be separately supported on steel beams spanning the opening over top of lintel members. This steel should never rest directly on the lintels but should be raised clear of lintel and be supported from a pad stone, not exceeding in width the narrow diameter of column drum, carefully bedded on top of capital. Lintel stones may abut this pad stone at sides with a facing to fill the space between same and carry the architrave mouldings across the top of column cap.

Arches.—The voussoirs of ordinary arches not extending entirely through wall are generally made of an even depth; this depth may, to some extent, be regulated by the depth of reveal of the openings which they span but should almost invariably be either 4 inches or 8 inches deeper than the normal thickness of ashlar facing in all stone faced buildings and generally at least 8 inches deep in limestone trimmed brick walls.

The arch stones should always be at least the full depth of reveal. Working to brick-units of depth will facilitate the backing up, avoiding a lot of cutting, fitting and waste of the backing and permit the building of backing or relieving arches of brick work in standard units of thickness, to which the stone arch should be anchored.

The voussoirs of large or heavy loaded arches should generally be both bonded and anchored to the brick arch in back of same for which purpose the alternate voussoirs, starting with key stone should be made 4 inches thicker.

It is never advisable to detail arches for a bedjoint between voussoirs of less than a full quarter inch, even when 3/16-inch joint may be required elsewhere throughout the work, as the proper thorough bedding of arch stones is important.

Inventions Limited, are distributing an attractive booklet on "Rawlplugs." The booklet describes the various uses to which these may be put, with a variety of interesting illustrations, and closes with opinions of architects, builders, electricians, etc., who have had practical experience in the use of rawlplugs.

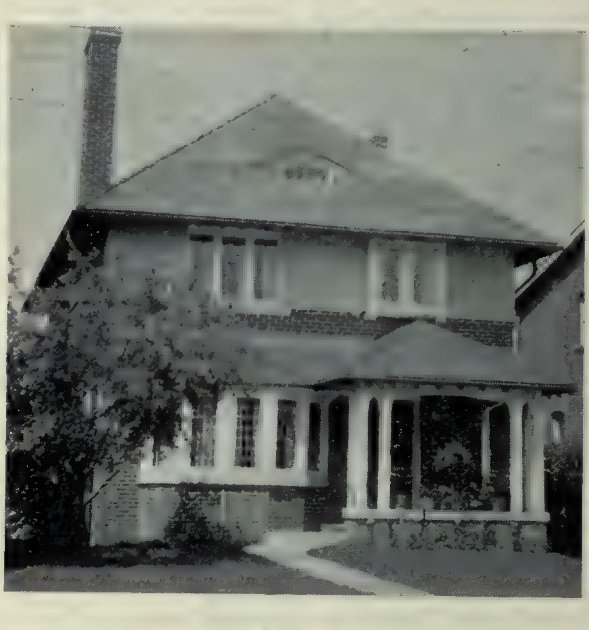
The Contract Record's

Weekly House Suggestion No. 27

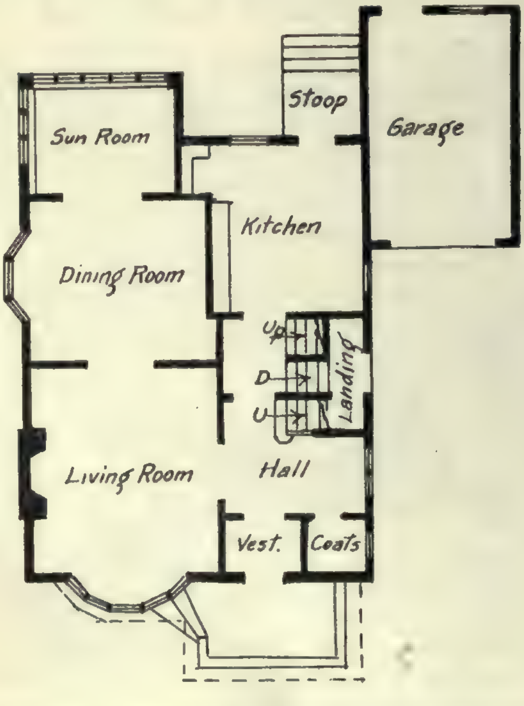
The subject of our article this week is an excellent example of the well-planned, medium-sized residence. It was designed for Mr. J. Frank Raw, by Messrs. Molesworth, West & Secord, architects, Toronto, and was erected on Rushton Road in that city recently. The general construction is red pressed brick, with cement stucco trim on the second floor. The beautiful large bay window on the living room and the attractive entrance porch are the features of the front exterior. There is a roomy garage situated at the rear, with driveway from Rushton Rd., as seen in the accompanying illustration.

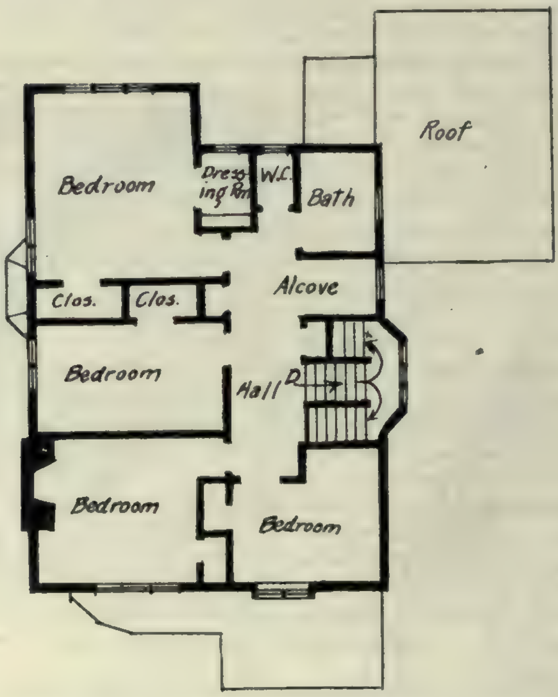
The feature of the ground floor is the large living room, with entrance through double glass doors from the front hall. This room has beamed ceiling, is trimmed in oak, with oak floors, and has a handsome brick fireplace in the south wall. Double glass doors also lead to the dining room. This latter room is equipped with a built-in china closet, situated in the northeast corner of the room. There is also a large bay window in the south wall, as seen on sketch plan, which provides this room with an abundance of uatnral light. On either side of the entrance to the sun room, at the rear or the dining room, there are built-in bookcases, with ornament alcoves above. There is a shelving along the south and west walls of the sunroom for flower boxes. The kitchen, as seen on floor plan, is conveniently situated to the dining room, with entrance from that room and from the rear hall, and contains all modern service features, such as built-in ironing board, broom closet, etc. As in the living room, floors and trim throughout the ground floor are of oak.

There are staircases in the rear and front halls to a landing, with single staircase from landing to second floor. This floor is divided into four bedrooms and bathroom, with separate dressing room in connection with the main bedroom, all rooms being conveniently located off the upper hall. The front bedroom has a tile fireplace in the southwest corner and is equipped with roomy closet. The main bedroom, situated at the rear over the dining room, and sunroom, is a large bright room with small separate dressing room off it, as seen on plan herewith. There is a large mirror in the door to the clothes closet in the main bedroom. The bathroom is floored with white tile and there is a separate W. C.



The full sized basement contains large boiler room, storeroom, coal room and laundry, the latter being equipped with built-in tubs and receptacle for soiled clothes.





Mainly Constructional

East and West—From Coast to Coast

Reid Bros., General Contractors, have moved their offices from 535 Guy St., Montreal, to corner of Tower and St. Catherine Sts.

Toronto has set a new record in building permits issued in one day, 90 permits being granted on June 10, for a total value of $250,000.

A report from Ottawa states that there is a scarcity of building labor at that point, bricklayers and stonemasons being especially scarce.

The steel contract for the Gerrard St. bridge at Toronto has been awarded to the Canadian Allis-Chalmers Company, of Toronto, which will involve the fabrication and erection of over a thousand tons of steel work.

The city council at Montreal recently authorized the construction of a 25,000,000 gal. storage basin for filtered water, to cost $641,250. This is part of the huge improvement scheme of the Montreal water supply system.

Over 1,000,000 cubic yds. of material will be involved in the contract which the National Sand & Material Company, of Welland, has just secured for the sand and gravel to be used on sections 3 and 4 of the Welland Ship Canal.

Montreal is considering the appointment of a city planning board, whose duties will consist of advising the city council on the location and embellishment of parks, playgrounds and highways.

There is a rumor of the establishment of large pulp mills between Elko and Waldo in the Crow's Nest Pass district, British Columbia, by a syndicate of Chicago newspapers. The sum of $3,500,000 is mentioned as the amount involved in the financing of this undertaking.

Montreal is trying out water meters in each house of the Cote des Neiges district. It was found that water for this district was costing about double the amount of revenue derived for this service in this particular ward and it is believed that this move will mean a big saving for the city.

Durant Motors of Canada, Limited, Leaside, Ont., are contemplating extensive additions to their present plant. Two buildings, three storey high, and a large shipping building constitute the bulk of this program. These new structures will increase the floor space of the plant to 400,000 sq. ft.

The annual summer meeting of the Saskatchewan Branch of the Engineering Institute of Canada was held at Moose Jaw, on Friday, July 14. The program included a business session, the inspection of the local sewage disposal plant, power plant and other civic institutions, and a dinner in the evening at the new C. P. R. Depot.

Dr. J. W. Ross, Canadian Trade Commissioner, Shanghai, China, and Major G. B. Johnson, Canadian Trade Commissioner, Glasgow, Scotland, will shortly visit Canada to get into personal touch with exporters to those countries with a view to development of Canada's overseas trade. The two commissioners will make a tour of the Dominion.

The members of the Cleveland Builders' Exchange enjoyed their annual week's outing recently at the Bigwin Inn, Lake of Bays, Ont. The party numbered about 200. Several entertainment features were introduced by the management of the hotel for the amusement of the visitors, including a band concert by the well known Anglo-Canadian Concert Band, and a banquet on July 4, in the large dining room.

A new organization at Toronto, known as the Toronto Real Estate Corporation, Limited, has been formed to construct small houses in the Regent Park, McMaster Heights and Vaughan Road districts. A start will be made almost immediately on the company's program, which will include a number of houses to be sold as low as $1,500. C. S. Pote is president and managing director of the new organization and W. T. Rogers is vice-president.

Tenders have been called for the construction of the proposed $2,000,000 C. P. R. ocean steamship pier at Vancouver, and as soon as the contract has been awarded work will go ahead. The sub-structure of the pier has been constructed for some time. The dimensions of the completed structure will be: length, 850 ft.; width, 330 ft., with accommodation for the large new Pacific liners. It will be constructed in two storeys and will be equipped with all modern conveniences for freight handling.

The petition of the Vancouver and District Joint Sewerage Board to the provincial government for assent to borrow one million dollars to carry on work and to provide for future work has been passed by an order-in-council at Victoria. The board are using $600,000 of this for the Collingwood storm sewer. A committee consisting of Mayor Tisdall, Reeve Lembke and Mr. Jas. Stables, chairman of the board, has been appointed to arrange for the bond issue of $600,000 for the storm sewer.

A new industry, known as the Fonthill Concrete Products, recently completed the construction of their office building at Welland, Ont., and the foundation of the main plant building at the N. S. & T. station grounds is also ready for the superstructure. The establishment of this plant was delayed pending negotiations with the railway for an extension on the original site, which the company has now obtained. The products of the new company will be concrete drain and building tile and concrete brick. They will also carry a complete line of builders' supplies.

Personal

Mr. Charles D. Campbell, of Hamilton, has been appointed to succeed Mr. John G. Mill, as city engineer of Belleville, Ont. Mr. Campbell is a graduate of the University of Toronto in applied science and for five years was city engineer of Galt, Ont. He was also resident engineer of the Galt, Preston and Hespeler Railway.

Obituary

Mr. Henry Rapine, contractor of McKillop Township, Ont., was accidently killed recently, when the concrete wall of a tank on which he was working caved in, a large piece of cement striking him on the head. Deceased was 65 years of age.

Trade Incorporations

Premier Housing Co. Ltd., with head office at Montreal, capital $20,000, to build houses.

Consolidated Stone, Limited, with head office at Montreal, capital $20,000, to manufacture and deal in limestone and marble.

Laval Quarry Co., with head office at Cap St. Martin, P. Q., capital $49,000, to carry on a stone quarrying and building business.

CONSTRUCTIONAL ACTIVITY

Period of July 12 to July 18, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Alvinston, Ont.
Town Council plan erection of pump house and installation of electrically operated pumps. John Irving, clerk.

Burlington, Ont.
Mr. Sykes, Town Clerk, has plans and will receive tenders, no closing date set, for Tarvia macadam roadway on Caroline St., to cost $7,000. Plans also with MacKay & MacKay, Engrs., Home Bank Bldg., Hamilton.

Plans are being prepared for storm sewers on Caroline St. for Town. MacKay & MacKay, Engrs., Home Bank Bldg., Hamilton.

Plans are being prepared for pavement on Burlington Ave. for Town. Mackay & MacKay, Engrs., Home Bank Bldg., Hamilton.

Chilliwack, B. C.
Plans are being prepared for sewerage system to cost $26,000 for Council. C. Breckenridge, Engr., Chilliwack.

Hamilton, Ont.
City Council contemplate following work: Asphalt pavement on Gibson Ave., $20,000, Cannon St., $17,000 Connaught Ave., $12,000, Edgemont Ave., $10,000; paving on Wentworth and King Sts.; sewer on Cumberland Ave.; concrete sidewalks and curbs on Roxboro and Paling Aves., concrete curbs on Jackson St.; gulley drains on both sides Edgemont Ave. E. R. Gray, Engr.

Merritton, Ont.
Richard Clark, Town Clerk, will receive tenders until July 24th for construction of concrete pavement on Hartzell Rd. Plans with F. N. Rutherford, Engr., 24 Queen St., St. Catharines.

Metcalfe Twp., Ont.
C. C. Henry, Commr., R.R. No. 1 Walkers, Ont., will receive tenders until Aug. 5th for construction of the Moore Munro drain.

Montreal, Que.
J. L. Boulanger, Deputy Min. Prov. Dep't. of Roads, Quebec, will receive tenders until Aug. 1st for roadwork on Montreal-Sherbrooke Highway. Plans with G. Henry, Engr., Parliament Bldgs., Quebec.

J. L. Boulanger, Deputy Min. Prov. Roads Dep't., Quebec will receive tenders until Aug 1st. for roadwork on Montreal-Toronto Highway. Plans with G. Henry, Engr., Parliament Bldgs., Quebec.

Ottawa, Ont.
City Council plan construction of asphalt pavement on Parent Ave. and Sherbrooke St. A. F. Macallum, Commr. of Works.

Owen Sound, Ont.
Tenders will be called shortly for construction of concrete sidewalks to cost $11,000 for City. D. J. Fleming, Engr.

Timmins, Ont.
H. E. Montgomery, Town Clerk, will receive tenders until July 24th for construction of sewers and watermains. Plans with J. F. Henderson, Engr.

Toronto, Ont.
Tenders will be received until July 25th for laying water pipes, etc., on Craighurst and Glengrove Aves. Plans at Room 320, City Hall.

Turnberry Twp., Ont.
Paul Powell, Wingham, Ont., clerk Turnberry Twp. Council, has plans and will receive tenders until July 24th for construction of the Armstrong drain and branches.

Waterloo Twp., Ont.
P. A. Snider, R.R. No. 1, Breslau, Ont., Clerk, Waterloo Twp. Council, has plans and will receive tenders until July 29th for construction of municipal drain. Plans also with Herbert Johnston, Engr., 103 Frederick St., Kitchener.

CONTRACTS AWARDED

Barton Twp., Ont.
Twp. Council awarded contract for sidewalks to Chas. Bailey, Hamilton. Contract for roads is placed with Alex. Inch, Mountain Top, Hamilton.

Cornwall, Ont.
General contract for construction of pavement on Pitt St., for Council is awarded to McLean & Stidwell, Cornwall. Contract for sheet asphalt is placed with Standard Paving Ltd., Central Chambers, Ottawa.

Prince George, B. C.
General contract for roadwork costing $25,000 on Cariboo Rd. between Prince George and Hixon Creek for Prov. Dep't. of Pub. Works is awarded to E. J. Ryan Contracting Co., 5 Fairfield Bldg., Vancouver.

Southwold Twp., Ont.
General contract for construction of concrete highway from Talbotville 2 miles north for Prov. Gov't. is awarded to Lumsden Engineering & Transport Co. Ltd., 6 Adelaide E., Toronto.

Toronto, Ont.
Contract at $64,694 for sewers on Ruskin Ave., for City is awarded to W. R. Worthington, 555 Markham St. Contract for sewers on Mt. Pleasant Rd. is placed with Grant Contracting Co., 50 Front E.

Westbourne, Man.
General contract for 20 miles grading for Municipality of Westbourne is awarded to A. R. Boivin, 305 Notre Dame Investment Bldg., Winnipeg.

Railroads, Bridges and Wharves

St. Louis de France, Que.
St. Maurice Lime Co., plan construction of rly. siding to cost $20,000. Chs. Godin, Engr.

CONTRACTS AWARDED

Fort William, Ont.
General contract for erection of freight office costing $15,000 for C.P. Rly. is awarded to J. McDiarmid Co., Winnipeg.

Revelstoke, B. C.
General contract on unit basis for construction of steel highway bridge over Columbia River for Prov. Gov't. is awarded to Grant Smith & Co. & McDonnell Ltd., Vancouver. Contract on unit basis for superstructure is awarded to Hodgson, King & Marble, Vancouver. John Coughlan & Sons, Vancouver, have contract for steel.

St. Raymond de Pennafort de Weedon, Que.
Steel contract for construction of steel bridge costing $30,500 for Town is awarded to McKinnon Steel Co. Ltd., Drummond Rd., Sherbrooke, Que.

St. Tite, Que.
General contract for construction of reinforced concrete bridge costing $10,000 for Town is awarded to Trepanier & Beaudry, Three Rivers, Que.

Sydney, N. S.
F. A. Morley, 905 George St. has contract for construction of reinforced Engr.

Public Buildings, Churches and Schools

Amherstburg, Ont.
Tenders will be called shortly for erection of parish hall to cost $17,000 for Christ Episcopal Church. Harold McEvers, architect, Victoria Block, Windsor, Ont.

Bedford, Que.
Erection of school is contemplated by School Bd. F. Fortin, secy.

Bertie Twp., Ont.
Plans will be prepared for school to cost $22,000 for S. S. No. 4, Bertie Twp. Chester Fritz, secy., R.R. No. 1, Fort Erie.

Brandon, Man.
Plans are being prepared for alterations to hospital for Brandon Hospital Bd. W. H. Shillinglaw, architect, 302 Russell St.

Canso, N. S.
R. C. Desrochers, secy. Dep't. Pub. Works, Dom. Gov't., Ottawa, will receive tenders until July 25th for hot water heating system for Post Office. Plans with Chief Arch., Dep't. Pub. Works, Ottawa, Clerk of Works, Halifax, and caretaker, Pub. Bldg., Canso.

Chatham, Ont.
J. P. Dunn, 40-5th St., secy. Separate School Bd., will receive separate tenders

ESTABLISHED 1886

Contract Record
and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL	119 Board of Trade Bldg.
WINNIPEG	302 Travellers' Bldg.
VANCOUVER	Winch Building
NEW YORK	296 Broadway
CHICAGO	14 West Washington St.
LONDON, ENG.	16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U.S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, July 26, 1922 No. 30

Calcium Chloride for Curing

The value of calcium chloride in highway construction has been demonstrated to such an extent during the last year by actual practice and laboratory experiments that the Division of Highways of Illinois has not only allowed its usage to accelerate the setting of concrete in cold weather construction, but is also advocating it as a simple and practical method of curing.

Laboratory investigations were conducted on a large scale, according to an article in "Successful Methods," more than 450 specimens having been made and tested for transverse strength. In all of the experiments made the specimens treated with calcium chloride showed the best results. Several methods of applying this chemical were tried and the greatest strength was shown by the specimens, the bare surface of which was sprinkled with granulated chemical in the proportion of 3 lb. per sq. yd. of surface. This method of curing brought greater strength to the specimens at the end of 14 days than did the wetted earth method at the end of 28 days.

It was thought that heavy rains might wash the calcium chloride from the pavements and thus destroy its usefulness. Accordingly, tests were made with specimens from which the granular chemical was washed off 12 hr. after its application. The results of these tests seemed to prove conclusively that the beneficial effect of calcium chloride occurs chiefly within the first 24 hr. of its stay on the concrete. As in the usual course the chemical is applied to the pavement in from 8 to 16 hr. after the concrete is finished, it would be an easy matter to protect it from rainfall for 24 hr. if the weather looked threatening, or to make the second application in case the first was washed off.

The actual curing of concrete pavements with calcium chloride was tried with favorable results in a few cases during the last construction season. In one case 7 miles of pavement were cured by first covering the pavement with about an inch of earth and then sprinkling the earth covering with a rich solution of calcium chloride, applied so as to insure approximately 4 lb. of the chemical per square yard of surface. The earth covering was felt to be necessary to hold the solution on the surface of the road and to prevent loss in case of a heavy rain.

The solution for curing was taken from water barrels placed at certain points along the road the day before pouring the slab. When the road was finished the proper amount of calcium chloride solution was applied to the earth covered surface of the pavement with an ordinary sprinkling can. Inspection was made frequently and results proved most satisfactory.

Rebuilding of Victoria Store

The Arcade Building, Destroyed by Fire, Is Being Reconstructed—Outer Walls Sound

The contract for rebuilding of the Arcade building, Victoria, B. C., has been awarded to Messrs. Luney Bros., Victoria, B. C., for a sum in the neighborhood of $85,000 and work is commencing at once. This building, which was almost completely gutted by fire on May 10th, (Contract Record of May 31st, page 511) requires almost complete reconstruction, and the contractors have cleared away the entire remains of the interior, which was a mass of charred timbers and twisted debris. The outer walls, however, are in sound condition and will be used in the rebuilding, which will be, it is stated, of a more solid and fireproof nature than was the case with the original structure, which was built under special conditions during war-time. Percy Fox, of Victoria, is architect, and Messrs. Spencer Ltd., the owners of the building.

Rebuilding operations on the Arcade building, Victoria, B.C.

Estimating the Cost of Plain Concrete Work in Buildings

Methods of Calculating Quantities and Figuring Costs—Data of Practical Value for Estimating Purposes—Analysis of Factors Involved in Forming and Concreting Operations

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It is our attention, in so far as it is practicable to do so, to make each one of these articles complete in itself. However, there is hardly an operation in general building construction that is so unique that much that may be said of another operation will not apply to it as well.

For this reason, it will often be necessary for a reader to master several different articles before he will become really proficient in estimating the class of work covered by any one of them.

For instance, while this present discussion of the method of estimating the cost of plain concrete will be rather lengthy, the reader must also thoroughly master the articles on excavating, brickwork, reinforced concrete and timber framing, if he would get the best results in this particular work.

It is well to adopt a uniform procedure when surveying quantities for any kind of work, particularly so for concrete work. The best method is to start at the beginning and list the different items in approximately the same order in which they will be constructed. Thus, wall-footings, pier-footings, walls, piers, etc. Also follow a regular system of setting down the dimensions, viz., length first, width or thickness second, and height third. This method will always make it practicable to know just what each figure means and will also facilitate the calculation of form quantities.

Figuring Formwork

It hardly seems necessary, at this late date in concrete construction, to stress the importance of carefully figuring all formwork, either by the number of square feet of contact area or by the number of board feet of lumber to be used, and not by lumping the cost of form-work into the cost of a cubic yard of concrete.

As a general rule, I use the contact area method because it gives very close results and is sufficiently accurate for all ordinary kinds of construction. For unusual work that would involve difficult, extra strong, or intricate form-work, the design of the forms should be worked out before estimating and the cost carefully computed on the basis of the material to be used and the work to be done.

In scaling quantities for concrete work I usually set my figures down in a form like that in the next column:—

The figures in parentheses indicate that there is a plurality of items of like dimensions.

It is evident that the multiplication of the dimensions by each other (and by the figures in parentheses when there are any) will give the volume of concrete, in cubic feet, of each item, and the addition of the products will give the total volume; dividing it by 27 we get the quantity in cubic years.

The calculation of the contact area of form-work is equally simple and does not necessitate a new survey of the plans, provided the figures have been written down in the order specified.

For instance, two runs of footings, each 32 ft. long and 1 ft. thick will require a line of forms on each side of the footing and, except at the ends, the quantity of forms will not be affected by the width of the footing.

Plain Concrete Work	Forms
Wall Ftgs.	
(2) x 32-0 x 2-8 x 1-0	
(2) x 24-8 x 2-8 x 1-0	
(2) x 6-0 x 2-0 x 1-0	
4-0 x 2-0 x 1-0	
Pier Ftgs.	
(4) x 2-6 x 2-6 x 1-0	
(4) x 2-0 x 2-0 x 1-0	
Walls	
(2) x 30-10 x 1-6 x 9-0	
(2) x 25-10 x 1-6 x 9-0	
(2) x 6- 1 x 1-0 x 9-0	
Piers.	
5- 0 x 1-0 x 9-0	
(4) x 1-0 x 1-10 x 8-0	

Therefore, multiplying the dimensions given, except the second, and doubling the product will give the area of the forms required, except that allowance must be added for the ends of the form. In a case where footings of equal width abut, the saving of forms at the side will equal the form used at the end and no calculation need be made.

Since pier-footings and piers stand alone, it is evident that the forms extend entirely round them; therefore, the area of forms for any such footing or pier is twice the sum of its two horizontal dimensions multiplied by the height. By following this same general method throughout it is possible to calculate the area of forms for any concrete work with very little labor. Discussion of the cost of form materials and labor will be given a little further on.

Quantities of Material in Concrete

Calculation of the quantities of materials required to produce a cubic yard of concrete is now reduced to the simple operation of referring to a table. Numerous such tables, in many varying forms, have been published, but the one on the next page is sufficently complete for all ordinary uses. Most of the cement companies publish similar tables in handy pocket "calculator" form and are glad to furnish them without cost to people having need of them.

This is about as wide a range of proportions as is found in ordinary building work, except cement finish work, which is covered in a later section of this article but in reinforced concrete work it is often necessary

Table of Quantities of Materials Required to Produce One Cubic Yard of Concrete in Place

In each column, the quantities appear in the following order: Bbls. Cement, Cubic Yards Sand, Cubic Yards Gravel or Stone.

Nominal Proportions	1" Stone & Under Dust Screened Out			2½" Stone & Under Dust Screened Out			2½" Stone & Under Most Small Stone			3/4" Gravel & Under Sand Screened Out		
1-2-3	1.46	0.44	0.89	1.48	0.45	0.90	1.53	0.47	0.93	1.34	0.41	0.81
1-2½-5	1.19	0.46	0.91	1.21	0.46	0.92	1.26	0.48	0.96	1.10	0.42	0.83
1-3-5	1.11	0.51	0.85	1.14	0.52	0.87	1.17	0.54	0.89	1.03	0.47	0.78
1-3-6	1.01	0.46	0.92	1.02	0.47	0.93	1.06	0.48	0.97	0.92	0.42	0.84
1-3-7	0.91	0.42	0.97	0.92	0.42	0.98	0.94	0.42	1.05	0.84	0.38	0.89
1-4-7	0.83	0.51	0.89	0.84	0.51	0.90	0.87	0.53	0.93	0.77	0.47	0.81

to use much richer mixtures in columns or other places where great compressive strength is required.

Portland cement is always sold by the barrel, practically 3.8 cubic feet, and it is usually delivered in cloth sacks holding one-quarter barrel each. Delivery is sometimes made in paper bags of the same size, less frequently in wooden barrels, and occasionally in bulk car-loads.

Sand, gravel and crushed stone may be sold either by the cubic yard or by the ton. Since the quantity of materials to be used will be figured on the cubic yard basis, prices per ton should always be converted to prices per cubic yard.

It is always advisable to obtain the correct weight per cubic yard of any material which you propose to use but, in the absence of more definite information the following weights may be used:

Sand.	2,700 lbs. per cu. yard
Gravel,	2,700 lbs. per cu. yard
3/4" crushed trap rock	2,600 lbs. per cu. yard
1½" crushed trap rock	2,550 lbs. per cu. yard
1½" crushed lime stone	2,360 lbs. per cu. yard
3/4" crushed granite	2,500 lbs. per cu. yard
1½" crushed granite	2,400 lbs. per cu. yard
Crushed slag	2,000 lbs. per cu. yard

When figuring upon slag-concrete, as a substitute for stone or gravel-concrete, keep in mind the fact that you will probably need at least one-fourth more mortar in your mixture than you would to get a concrete of the same consistency with stone or gravel.

Whenever possible, it is well to get prices on all materials delivered directly to the site of the work. However, this is not always possible and the information given here, as well as that contained in the lessons on excavating and on brickwork, will enable you to figure your own delivery costs.

Delivery Costs

A bag of cement weighs 96 lbs., for convenience in estimating it will be considered as 100 lbs., therefore, the load handled by a two-horse team will be about as follows:—

On poor earth roads, 2,000 lbs.,=5 bbls. cement
On fair earth roads, 2,500 lbs.,=6¼ bbls. cement
On good earth roads, 4,000 lbs.,=10 bbls. cement
On hard surfaced rds., 6,000 lbs.,=15 bbls. cement

On level grades, the rate of travel will be two miles per hour with the load and three miles per hour with the empty wagon.

If you figure on the use of a motor truck, you can consider that it will carry its rated load and the speed will vary from eight miles per hour for poor roads up to twelve miles per hour for good roads. Trucks can operate at greater speeds and can carry more than their rated loads, but this is only at a greatly increased cost of maintenance.

The time required for loading, and the labor cost of loading, can be figured as follows:—

From box car onto wagon, about one minute laborer's time per bag.

From ordinary cement shed onto wagon, one and one-quarter minute of laborer's time per bag.

Thus, with three men working, a load of 15 bbls., (60 bags) will require the wagon to stand for 20 minutes if loaded from the car and 25 minutes if loaded from the shed. If the force is larger, the time will be reduced proportionately.

Unloading will require three-quarters of a minute of laborer's time per bag if placed on a pile and one and one-quarter minutes if placed into the shed.

In figuring the cost of cement do not forget to make allowance for the bags. Cloth bags are usually charged for at ten cents each and credited at the same price when returned, charges prepaid, in good condition to the cement company's mill.

Since there is no way of knowing in advance how many bags will be lost or damaged on the work, it is good practice to figure on a loss of one bag out of each four; this figure also to take care of the cost of return freight and handling charges. Paper bags or wooden barrels are not returnable for credit.

The Kind of Sand to Use

When sand or gravel must be obtained directly from the bank, the cost of obtaining it can be figured as explained in the article on excavating and due allowance must be made for the cost of stripping off loam or other worthless material.

The bank should be visited and as careful a computation as is practicable under the circumstances should be made of the quantity of material to be stripper off and this cost divided over the cost of the quantity of useable material required from the bank.

It will seldom be practicable to use a "bank-run" mixture of sand and gravel in concrete, but will usually be necessary to screen it to separate sand and gravel. Where it is practicable to set up the hand-screen at the bank, an allowance of thirty-five minutes of laborer's time will be sufficient for each cu. yard of the bank-run material. The proportions of sand and gravel that any bank will produce can only be determined by test, and such a test should always be made when estimating on important work.

A word of caution may be added here. Quite frequently a bank of sand may be entirely suitable for concrete as far as may be determined by visual examination, yet a chemical analysis or a test of a sample of concrete made from the sand may disclose the presence of vegetable acids or other impurities that would make the sand unsafe for use. It is well to investigate this feature thoroughly when estimating.

When sand, gravel or broken stone is purchased in carload quantities the following figures will govern; cost of carting from car to the work must be figured as previously explained and added to these costs. These figures are also to be used in computing the cost of moving material from a sand or gravel bank to the work. Figures are given in hours of labor time; the waiting time of the wagon will be determined by its capacity and the number of men employed in loading. The waste time of the men will be determined by the number of wagons employed and their headway interval.

Time in Labor Hours

	From Ground to Wagon		From Gondola Car to Wagon	
	Wet	Dry	Wet	Dry
Sand,	0.50	0.34	0.45	0.3
Gravel,	0.65	0.47	0.60	0.4
Crushed trap-rock		0.51		0.44
Crushed granite		0.49		0.42

Lost time of men and wagons may be reduced to a mimimum by the use of unloading boxes, which are hung on the side of the car and into which the material is shovelled . When a wagon is to be loaded it is driven under the box, the contents dumped into the wagon, the wagon driven away and the box made ready to receive the load for the next wagon.

The reader who desires to pursue the study of mechanical methods of handling concrete materials will find much valuable and interesting material in Gillette's "Handbook of Cost Data," and Dana's "Handbook of Construction Equipment."

Mixing and Placing

Now-a-days, very little concrete in building work is mixed by hand, the usual practice being to use a gasoline engine driven mixer. Steam mixers are used in some cases but they are coming into disfavor because of the need of having a skilled man—in many localities he must be licensed—to take charge of the boiler and engine. Electric motor driven mixers are also used at times, but they have not attained any great vogue.

Whether the mixing be done by machine or by hand, it must always be remembered that the number of yards of material fed into the mixer or onto the board will always greatly exceed the number of yards of concrete taken out.

For instance, 1-3-6 mixture, using 2½ inch stone and under with the dust screened out, will require for each yard of concrete: 0.93 cu. yd. stone, 0.47 cu. yd. sand. 0.15 cu. yd. cement, or a total of 1.55 cu. yd. of material which is the quantity that must be handled from stock-pile or cement-shed to the mixer.

Since this is dry material, the following figures may be used.—One laborer can handle and move any of the following quantities of materials a distance of forty feet in one hour:— 1.65 cu.yd. sand, 1.71 cu. yd. crushed traprock, 1.93 cu. yd. crushed limestone, 1.78 cu. yd. crusher granite, 2.22 cu. yd. crushed slag, 40 bags portland cement.

When the mixing is by machine, it is necessary to know the capacity of the mixer in cubic yards per hour for average running and the daily charge or rental rate of the mixer, as well as its consumption of fuel per day or hour. The manner of determining fixed charges or rental rates will be taken up in a later article.

Sometimes the capacity of a mixer is limited by a clause in the specifications which require that the concrete be mixed for a given number of minutes before discharging, but usually the time of the mixer is determined by the ability of the machine to deliver a well mixed product.

There are many records quoted ranging from a batch a minute upward, but it is hardly safe to figure on better than an average of fifteen batches per hour for the usual run of concrete work in building. Thus, if the mixer is a "one-bag" size it will turn out fifteen batches of 6.42 cu. ft. of mixed concrete each (ten cubic feet in-put each) when working on a 1-3-6 mixture, using 2½ inch and under stone with dust screened out. This equals 3.57 cubic yards of concrete. From the mixer, the laborers can each receive an average of 35 cubic feet per hour and wheel it a distance of forty feet and dump in into the forms.

Number of Men in Mining Operations

In addition to the number of men required to put the materials into the mixer and take the concrete away, allowance must be made for one man to tend the mixer, untie cement bags, etc., and at least one man to puddle the concrete into the forms. With each increase of one bag in the nominal capacity of the mixer, one additional man will be needed for puddling and helping to dump concrete and one extra man to assist around the mixer.

All of these statements apply to average conditions. When estimating careful attention must be given to all details to determine whether less favorable or more favorable conditions are likely to be encountered.

If the actual mixing is to be done by hand an allowance of 1.25 hours labor time must be included for each cubic yard of concrete. This covers the cost of doing the work that is done in the mixer and also the work done by the men tending the mixer.

To all of the above figures must be added the cost of a foreman and a waterboy. Their cost per cubic yard is found by determining the average production of the plant contemplated for the job under consideration.

The various mechanical means for placing concrete, after mixing, will be discussed in the article on "Reinforced Concrete Construction," while the cost of hoisting by the use of a platform elevator will be covered in the article on brickwork.

The cost of water for mixing, while a small item, must always be included in the estimate, as well as the cost of connecting with the supply. Some cities make a flat charge per cubic yard of concrete, others require that the supply be metered and payment made accordingly. About 26 gallons of water are required for mixing a yard of concrete, but including waste, water used for sprinkling and other purposes, the actual quantity used on the job will be more nearly 100 gallons per cubic yard.

After the concrete has set and the forms are removed it is usually necessary to smooth all exposed surfaces, erase form-board marks, and fill up hollow spots. Since the cost of doing this work is entirely dependent upon the care in building the forms and placing the concrete, it is a very difficult matter to determine the cost of finishing in advance.

However, the following figures may be used for all ordinary work:—

Number of Square Feet per Hour

	Laborers	Masons
Cement-wash	20	
Bush-hammer (hand-work)		5
Crandalling (hand-work)		5
Picking surface (Screen)	12	
Picking surface (Hand)	6	
Carborundum rub	7	

The cost of sand blasting will be taken up in the article on cement-gun work.

Runs for Construction Work

Nothing has been said thus far in this article about the cost of building runs for wheeling concrete. For ordinary plank runs the figures already given for moving concrete will be found large enough to take care of the usual amount of placing and moving. Where the nature of the work is such that it will be necessary to build trestles or other special forms of runs, they must be figured separately as will be explained in the article on timber-forming and on reinforced concrete construction.

Allowance must also be made for the cost of delivering equipment to the work and removing it at the completion. This is so variable a factor that it is difficult to give any rules for estimating. For instance, a small gasoline mixer may be so compact as to require practically no setting up after unloading from the car or truck, while a large steam mixer may require several days' labor in order to put it in running condition.

Cost of freighting equipment to and from the location of the work can be ascertained by inquiry of the carrier, and charges for unloading from car to truck and truck to car, or vice versa, will average about sixty labor-hours per carload.

Since the equipment must be loaded and unloaded on both trips and must be freighted back to headquarters, a fair sized job will have to bear the expense of two hundred and forty hours' loading and unloading labor, trucking costs at both ends, both times, and freight two ways.

When cement is to be stored at the work, sheds must be built for this purpose and having determined the size necessary on the basis of the maximum amount to be stored, the cost of the shed can be estimated in accordance with the methods outlined in the article on carpenter work. Credit can, of course, be taken for the salvage value of the lumber after the shed is no longer required.

Form Work

Practically all forms for concrete work in buildings are now constructed of 1 inch boards, supported by 2 x 4 studs spaced from 12 to 24 inches apart, depending upon the height to be supported or the load to be retained. Sometimes 1½ or 2 inch plank may be used for particularly heavy work or when so specified by the architect or engineer.

Since the usual method is to use 1 inch boards we will base our present estimates accordingly and the materials for 100 square feet of forms will be figured as follows:—

Actual area of form	100 sq. ft.	
Waste for Cutting, etc	15 sq. ft.	
	115 sq. ft. of	
1" boards or 115 ft. b.m. @ $27.00 per M.		$3.11
Studs 10 pcs. 2x4—109	67 f.b.m.	
Allowance for waste 15%	11 f.b.m.	
	78 f.b.m.	
78 f.b.m. studs @ $36.00 per M		2.81
Nails (approx. 40 lbs. per 1,000 f.b.m.) 8 lb. @ 5 cts.		.40
Tie-wire (approx. 25 lbs. per 1,000 f.b.m.) 5 lb. @ 6 cts.		.30
First cost of materials for 100 sq. ft.		$6.62

The cost of labor will be governed largely by the class of men employed. For instance, if local conditions make it necessary to have practically all of the work done by carpenters, the cost will naturally be higher than where a large port of it may be done by "handy-men."

On an ordinary job, where the laborers do all the handling of the lumber except the cutting, assembling and nailing in the building of the forms and also assist in the erection, each 100 sq. ft. of forms, allowing an average of two f.b.m. of material per square foot, will require the following:—

	Assembling	Erecting	Total
Footings.			
Carpenters' time	2½	½	3
Laborers' time	1	1	2
Foundation Walls.—(first ten ft. in height)			
Carpenters' time	3	1½	4½
Laborers' time	1½	1½	3
Each additional ten ft. in height			
Add.carpenters' time		½	½
Laborers' time		1	1
Piers (plumb sides)			
Carpenters' time	4	1½	5½
Laborers' time	1½	1½	3
Piers (pyramidal types.)			
Carpenters' time	5	1½	6½
Laborers' time	1½	1½	3
Steps, Lintels, Etc.			
Carpenters' time	7	2	9
Laborers' time	1½	2	3½
Slabs, Platforms, Etc.			
Laborers' time	1½	1½	3
Carpenters' time	6	1½	7½

All of these figures are based on the assumption that the lumber will not be moved over 200 feet from stock-pile to its position in use. For greater travel add ½ hr. laborer's time per 100 sq. ft. for each additional 100 ft. of travel.

After the concrete is hardened the forms must be strpped and cleaned if they are to be re-used, or removed if they are of no further use. For stripping, an allowance of 3 hrs. laborers' time per 100 sq.ft. must be made.

Re-use of Forms

When estimating the cost of forms for any concrete work, it is necessary to determine how many times the forms may be re-used, if at all, and what value, if any, will be left in the form lumber at the end of the work.

If the forms can be re-used, as when there are a number of members of the same dimensions, without any re-building, it is only necessary to figure the cost of material and of building the first time, and then to add the cost of stripping and re-erecting as many times as the forms will be re-used.

If the forms are only used once, the lumber may have a salvage value of as high as one-third of its original cost, depending upon how much cutting up has been done, but when the forms are used more than once it is not wise to figure upon much re-sale value unless you have a certain place to dispose of the lumber.

Where the forms may be used again, but only after re-cutting and re-assembling, it is not necessary to figure for new lumber again, but a new allowance of at least 15% for waste must be made and an allowance of 1/2 hr. carpenters' time per 100 sq. ft. must be made to compensate for the slower work on the used lumber.

A further discussion of the cost of forms and form-building will be given in the article on reinforced concrete construction.

Sidewalks, Floors, Etc.

You have already learned how to estimate the cost of handling the materials for concrete and of mixing the concrete and delivering it to the point at which it is placed in the forms. The same principles govern the estimating of the cost of side-walks, floors, etc., though it is usually easier to take off the quantities of sidewalks and floors by square feet and of base, curbing, etc., by lineal feet. The following table, originally published by me in "Concrete" for November, 1921, will enable you to quickly compute the quantities of materials required for any floor or sidewalk job.

Quantities of Materials Required Per 100 Sq. Ft. of Floors, Sidewalks, Slabs, Etc.

Note: Quantity of cement is given in barrels, aggregate in cubic yards.

Base Course

		1-2-4 Mix.	1-2-5 Mix.	1-2½-6 Mix.	1-3-6 Mix.
1″ Thick	Cement	0.45	0.39	0.37	0.31
	Sand	0.34	0.12	0.14	0.14
	Aggregate	0.28	0.30	0.28	0.28
2″ Thick	Cement	0.90	0.79	0.74	0.63
	Sand	0.27	0.24	0.28	0.28
	Aggregate	0.55	0.60	0.56	0.56
3″ Thick	Cement	1.35	1.18	1.10	0.95
	Sand	0.41	0.36	0.43	0.43
	Aggregate	0.83	0.90	0.85	0.85
4″ Thick	Cement	1.80	1.57	1.47	1.26
	Sand	0.54	0.48	0.57	0.57
	Aggregate	1.10	1.20	1.13	1.13
5″ Thick	Cement	2.25	1.96	1.84	1.26
	Sand	0.68	0.61	0.71	0.71
	Aggregate	1.37	1.50	1.40	1.41
6″ Thick	Cement	2.70	2.35	2.20	1.89
	Sand	0.82	0.73	0.86	0.85
	Aggregate	1.65	1.80	1.69	1.70
7″ Thick	Cement	3.15	2.74	2.57	2.40
	Sand	0.96	0.85	1.00	0.99
	Aggregate	1.93	2.10	1.97	1.98
8″ Thick	Cement	3.60	3.13	2.94	2.51
	Sand	1.09	0.97	1.14	1.14
	Aggregate	2.20	2.40	2.26	2.27
9″ Thick	Cement	4.05	3.52	3.30	2.83
	Sand	1.23	1.08	1.27	1.28
	Aggregate	2.47	2.70	2.54	2.55
10″ Thick	Cement	4.50	3.92	3.66	3.14
	Sand	1.37	1.21	1.41	1.58
	Aggregate	2.75	3.00	2.81	2.82
11″ Thick	Cement	4.95	4.31	4.03	3.45
	Sand	1.50	1.33	1.55	1.56
	Aggregate	3.03	3.30	3.09	3.12
12″ Thick	Cement	5.40	4.70	4.40	3.77
	Sand	1.63	1.45	1.69	1.70
	Aggregate	3.30	3.59	3.37	3.40

Top Course

		1-1 Mix.	1-1½ Mix.	1-2 Mix.	1-2½
½″ Thick	Cement	0.75	0.59	0.50	0.43
	Sand	0.12	0.14	0.15	0.16
¾″ Thick	Cement	0.18	0.21	0.23	0.24
	Sand	1.12	0.89	0.75	0.64
1″ Thick	Cement	1.50	1.19	0.99	0.85
	Sand	0.23	0.27	0.30	0.32
1½″ Thick	Cement	2.25	1.78	1.49	1.27
	Sand	0.34	0.41	0.45	0.48
2″ Thick	Cement	3.00	2.37	1.98	1.69
	Sand	0.45	0.53	0.59	0.63

		1-3 Mix.	1-1-1 Mix.	1-1-2 Mix.
½″ Thick	Sand	0.17	0.98	0.06
	Cement	0.37	0.50	0.41
	Aggregate		0.08	0.13
¾″ Thick	Cement	0.56	0.75	0.61
	Sand	0.25	0.12	0.09
	Aggregate		0.12	0.19
1″ Thick	Cement	0.74	1.00	0.81
	Sand	0.33	0.15	0.13
	Aggregate		0.15	0.26
1½″ Thick	Cement	1.17	1.50	1.21
	Sand	0.50	0.22	0.19
	Aggregate		0.22	0.38
2″ Thick	Cement	1.54	2.00	1.62
	Sand	0.58	0.30	0.25
	Aggregate		0.30	0.50

In addition to the necessary labor of handling the materials and mixing the concrete, the following labor must be figured upon:—

Per 100 Sq. Ft. Finish	
Carpenters setting screeds	0.4 hrs.
Cement finishers	3 hrs.
Per 100 Lin. Ft. Plain Base	
Carpenters setting grounds	1.5 hrs.
Cement finishers	3 hrs.
Per 100 Lin. Ff. Sanitary Base	
Carpenters setting grounds	1.5 hrs.
Cement finishers	4.5 hrs.

Be sure that you include all of the items of mixing, wheeling, hoisting, etc., that are involved.

When estimating floors or walks going on earth, be sure that you have an item in your estimate to cover excavating to the underside of the construction, and also any cinder or gravel course that may be specified.

For curbing, be sure that you include the cost of finishing top and face, also curb-bar, if specified.

Book on Accounting

Practical Accounting for General Contractors—by H. D. Grant of the staff of the W. B. Richards & Co., Accountants and Engineers; McGraw-Hill Book Company, New York, publishers. Little of a comprehensive nature has been written about a system of accounting to fit the needs of the contractor, and this book is designed to fill the gap. The necessity for such a book is evident for two reasons: First, practically all building and construction work is carried out by estimate and contract and, second, the basis of accuracy in estimating depends upon accurate record. The author has had a wide experience in the accounting side of the construction industry, and has evolved a system of accounts, and accounting control, which gives the contractor the information he requires for the management of his business. The contents of the book may be judged by the following chapter headings:—Requirements for Successful Operation; Types of Construction Contracts; Cost Plus Contracts; The Financial Accounts and Records; Figure Analysis Book; Handling Purchase and Store-Room Orders; Recording Income and Expense; General Ledger Accounts; Summary of Sequence of Operation; The Financial Statement; Cost Accounts and Unit Costs; Organization and Personnel; Classification and Symbolization of Accounts; Field Accounting Records; Handling Field Papers; Monthly Report to Owner; Payroll Problems; Control of Equipment; Preparation of Estimates and Bids; Municipal Contracts; Legal Aspects of Contracts, and Contractual Agreement.

Among the buildings programmed for early construction in Windsor are a 37-family apartment building, to be erected on the corner of Erie and Victoria, of fireproof construction throughout, and a store and apartment building on the opposite corner of the above streets, to include 5 stores and 4 apartments. Both these buildings will be of brick construction and will be modern in every respect. Mr. Gilbert J. P. Jacques is designing these structures.

The Water Supply of the Border Cities

Three Separate Organizations Furnish Water to the Border Municipalities—Efforts of the Essex Border Utilities Commission to Develop a Co-ordinated System for the Whole District

A report of the Essex Border Utilities Commission

There are three separate organizations supplying water in the Border Cities district; the municipal supply of the city of Windsor which also furnishes a supply to the town of Sandwich and the township of Sandwich West; the system of the Walkerville Water Company which supplies the needs of Walkerville, Ford City and part of the town of Riverside and the Eau Clair Water Company which cares for the lake shore residents east of their plant on River Front Road and for the village of Tecumseh.

The Windsor waterworks was inaugurated in 1871 and consists of the following structures and equipment. One 20" intake pipe, 296 ft. long laid, in 1871, one 30" intake, 622 feet long, laid in 1898 and one 60" intake, 500 feet long, laid in 1914. The old intakes terminate in wells in the pumping station, the new intake in a concrete screen well located 30 feet from the river bank and surmounted by a superstructure containing apparatus for lifting the screens and heating water to avoid frazil ice. There are four pumps, a Snow pump built in 1903 with a capacity of 6,000,000 gallons, an Inglis pump built in 1913 with a capacity of 8,000,000 gallons and two Rees-Roturbo centrifugal pumps of between five and six million gallons each. The boilers are four in number, 7 feet and 9 feet in diameter and 16 feet long. These were built in 1901-1902-1907 and 1916. The chimney is 48 inches in diameter and 108 feet high. The distribution system consists of about seventy miles of pipe varying from 3" to 20" in diameter. The published annual reports of the Windsor Water Commission indicated that the cost of service rendered is not high. The report of the Underwriters Association showed deficiencies which could be and are being eliminated. Low pressures often complained of are more frequently caused by insufficient capacity of distribution mains than by low pump pressures.

Walkerville's System

The Walkerville Water Company's system is owned and operated as a water company by Hiram Walker & Sons and the power plant and intake is located upon the property of and used in part by the distillery. The plant consists of two intakes; one 20" pipe extending 200 feet beyond the bulkhead and not now in use and one 48" steel pipe laid in 1909, having a crib on the intake and a screen chamber at the shore. The superstructure houses lifting apparatus for the screen and heating equipment for eliminating frazil ice. There are five pumps—three 3,000,000 gallon Worthington pumps built from 1894 to 1898, one 4,000,000 gallon Snow pump built in 1911 and one 10,000,000 gallon steam turbine centrifugal pump built in 1919.

The boiler plant is part of the main plant which supplies steam to the distillery. It consists of three 500 h.p. water tube boilers. These boilers are all supplied with mechanical stokers, economizers and coal bunkers with coal and ash handling apparatus. The distribution system consists of about twenty-two miles of cast iron pipe, varying in size from three to twelve inches. The water is pumped by Hiram Walker & Sons and delivered by them to the Walkerville Water Company.

The Eau Clair Water Company

The Eau Clair Water Company is located on Lake Shore Drive opposite Peche Island and has been in operation since June 1920. The intake is 8" in diameter and extends about 100 feet from shore to the channel bank. It terminates at the shore in a concrete well sixteen feet square and about eight feet deep. One motor driven centrifugal pump of 400,000 gallons per day capacity delivers water to an elevated tank 82 feet high, holding 20,000 gallons. The distribution system consists of about four miles of mains, six and eight inches in diameter.

The question of water supply and sewage disposal in a district where the geographical situation and topographical conditions of adjoining municipalities are such as are found in the Essex Border District make independent intelligent solution of these problems impossible. In 1910 a report of the Provincial Board of Health by Medical Inspector R. W. Bell made reference to "oft repeated" complaints regarding the pollution of the Walkerville water supply and he suggested that Windsor and Walkerville unite their water systems and take their water supply up the river three or four miles beyond all sewers near Lake St. Clair.

Recommended Joint Water Supply

The joint report on water supply and sewage disposal presented to the Commission under date of March 20, 1917, by Morris Knowles recommended for a water supply, an intake below Peche Island with pumping plant and purification works above Ford City and a trunk pipe line extending through the various municipalities with take-offs at various points to supply existing distribution systems. This plant was estimated to have a daily capacity of 17,000,000 gallons with ample provision for the maximum demand and was capable of unlimited extension as the district developed.

Early in 1917 the Commission endeavored to arrange with both the Walkerville Water Co., or the Windsor Water Commission for a quantity of water which would be supplied to the southern municipalities as required.

At a meeting of the Commission on July 11, 1917, a committee was appointed to meet both water boards and ascertain if some arrangement could be made either to buy or lease the plants and at what price or on what terms. This committee reported on October 24 that neither board was prepared to sell its plant but that Windsor would supply water at a price. On December 27 the secretary was instructed to write the Walkerville Water Company for a price at which they would supply the Commission with water and a joint reply was received from both boards on January 4, 1918. Instructions were issued on January 29 that arrangements be made for a conference between engineers representing all parties concerned. On February 11, the late T. Aird Murray discussed the project informally with the engineer of the Commission but was unable to go into the matter definitely nor would he allow his report and figures to be placed on the table. The Walkerville Water Company addressed the Commission on March 6, 1918, outlining their policy stating that they were willing to enter into a contract to supply water under certain conditions. This communication came before the Commission on April 22 and its engineer was authorized to confer with the Walkerville Water Co., with a view to supplying Sandwich, Sandwich West and Ojibway.

A conference was held on April 30 with officials of the Walkerville Water Co., but no proposition was secured, they requesting time to further consider the matter. Due to the illness of Mr. H. Walker further negotiations were suspended until July when the Walkerville Water Co., again wrote the Commission: "We hope to be in a position to submit a proposition to your committee shortly with regard to a supply of water for Sandwich, Sandwich West and Ojibway." Informal inquiries from the Walkerville Water Co., for a tentative form of contract were answered by draft agreements but nothing further has been received from them.

The water committee endeavored to secure information in accordance with a resolution of June 25 as to the contemplated expenditures for water supply plants and improvements throughout the district in order to make comparisons of cost with that of a combined plant as both Windsor and Walkerville had announced the preparation of plans for purification works with large capacities and letters were sent to their water boards and to the clerk of Ojibway.

The Walkerville Water Company replied July 11 1918, stating that they proposed to construct a 7.6 m.g.d. filter plant at a cost varying between $150,000 and $200,000. The clerk of Ojibway reported on August 2 a contemplated expenditure of $180,000 for a pumping station and purification works. The Windsor Water Commission was unable to give figures until December 1918, when they stated that the proposed filter plant costing $350,000 described in a published by-law was "in the opinion of the Board sufficient to take care of all requirements for every purpose for a number of years to come."

Direct Distribution

Prior to September 24, 1918, the Essex Border Utilities Commission had considered only the question of supplying water in sufficient quantity and acceptable in quality to each of the municipalities at wholesale cost, they in turn to distribute to the consumer. Subsequent to this date, however, the advantages and disadvantages of distributing water directly to the consumer from one source were the subject of much discussion. On March 7, 1919, a report was submitted to the Commission by the Water Committee dealing directly with this phase of the question and under date of July 2, the engineer's report was presented to the Commission giving consideration to those factors. This report was adopted by the Commission and steps initiated to bring the matter before the ratepayers for approval. Hearings were held with the various councils in an endeavor to submit the question to the people at a special election. This course was not followed by all municipalities, the city of Windsor notifying the Commission on August 22 that the council had decided to place it before the electors in the following January. The report which had been submitted to the various municipalities asking them to submit that by-law was withdrawn on September 29.

The Windsor City Council on November 24 authorized their city engineer to employ an independent engineer to valuate Windsor Waterworks plant and on December 8, E. M. Proctor submitted his report to the Windsor Council. As an outcome of this report, the city of Windsor appealed from the apportionment set out in the report of July 2, 1919, upon which the by-law was based. A hearing was heard on February 3, 1920, before the Ontario Railway and Municipal Board and enlarged until March 9. On March 6, a joint meeting of the Windsor Water Commission and representatives from the Commission was held and as a result of this conference, Windsor withdrew its appeal on the report of the engineers of the Commission and the Commission withdrew its report of July 2 from the various municipalities.

Report of Engineering Board

Following this action, an engineering board of three members was named, E. M. Proctor to represent the city of Windsor, F. W. Thorold the appointee of the town of Walkerville, and Morris Knowles as the engineer for the Commission, they to bring in an independent report for the solving of the Border Water Supply problem. On August 18, their report was presented verbally to the Commission by F. W. Thorold, chairman of the Board and was adopted on October 13 for filing with various municipalities.

In this report a recommendation was made to construct an intake, filtration plant and a pumping station at Strabane Ave., to deliver water through a gravity main into the suction wells of the Windsor and Walkerville pumping stations. The Walkerville Water Company has a franchise which does not expire until 1952 and the engineers board deemed it unwise to interfere with this at the present time, even if it were legally possible. Until that time then, the Commission will merely supply filtered water to the two existing pumping stations which will deliver water as they are doing at present and all rates, collections and water organizations in the various municipalities will be subject to the same control as at the present time. At the end of that period or prior, should amalgamation have taken place, the filtration plant will have been located upstream well above shore pollution and can be combined with a pumping station to serve the entire district should the people so desire. All previous reports on water supply were superseded by this joint and unanimous report made as it was by three engineers appointed by the municipalities most interested, who might reasonably be expected to safeguard the interests of their employer in any report they made.

Owing to the unsettled condition of business and finance prevailing during the latter part of 1920, the Commission notified each of the municipalities to withdraw the proposed by-law on this project and defer action until such time as might be deemed advisable.

On October 21, 1921, the Water Committee recommended to the Commission that the water project be submitted to the electors at the next annual meeting. Some of the newer commissioners were unfamiliar with the report and were not prepared to support the recommendation. It was decided that a conference should be arranged with the Windsor Water Commissioners, and the Walkerville Water Company to ascertain their view point before placing it before the people.

Sewage Disposal in the Border Cities

A Metropolitan Scheme Under the Jurisdiction of the Essex Border Utilities Commission—Ford, Walkerville, Sandwich and Ojibway Served by Two Interceptors, Eliminating Objectionable Outlets and Freeing River from Pollution

In 1915 the town of Ford City had a population in excess of 2,000 but was without any definite system of sewers. A report had been prepared in 1914 which was disapproved by the Provincial Board of Health as it called for outlets into the Detroit River above the intakes of the Walkerville and Windsor waterworks. The construction of sewers for this municipality could not be indefinitely postponed but at the same time the existing water supplies required full measure of protection.

On July 27, 1916, a meeting of the engineers representing the various municipalities within the jurisdiction of the Commission was called by Mr. William Woollatt, Chairman of the Commission, at the Windsor City Hall. This meeting was called for the purpose of effecting the organization of a Board of Engineers appointed by the respective municipalities. M. E. Brian, B.A.Sc., A.M.E.I.C., city engineer of Windsor was elected chairman of the Board. A general discussion of the problems confronting the border municipalities ensued and the engineers adjourned to meet later, undertaking to collect in the meantime all the available information. At a special meeting of the Board of Engineers on August 10, 1916, the data collected by the various engineers was discussed and it was recommended to the Commission that an engineer be appointed to make a preliminary report on the works required and that the Board of Engineers be retained to act in an advisory capacity.

The Essex Border Utilities Commission, acting upon the recommendation of the Board of Engineers, selected Morris Knowles of Pittsburg to make a report on a Metropolitan Water Supply and Sewage System called for by the enabling Act. In March, 1917, a complete report was submitted to the Commission dealing with these related questions.

Single Joint Sewage Scheme

A single joint sewage scheme to protect the entire water front was proposed as being most economical both in first cost and operating charges. In brief, it proposed an intercepting sewer parallel to the river front on Sandwich, Bedford and Main Streets from Pellette Road in Ford City to Fourteenth St., in Ojibway, meeting at a disposal plant in Sandwich between Chewett and Detroit Streets. As an economic factor, it was designed for domestic sewage only, with storm overflows into the river, as all sewage would require to be pumped on reaching the disposal plant. Two recommendations were incorporated in the report for immediate consideration:

(1) That the sewage of Ford and Walkerville be collected at once in an intercepting sewer and be delivered to a pumping station near the West main sewer in Walkerville and there lifted to an intercepting sewer connecting with the Parent Ave. sewer outlet, thus removing all sewage from the river above the present intakes.

(2) That Ojibway and parts of Sandwich West proceed to construct sanitary sewage systems and deliver same to an intercepting sewer extending to Park St. in Sandwich where it will be pumped into the Park St. outlet.

The estimated cost of the work based on labor and material costs as in the fall of 1916 was $210,000 and the apportionment as ordered by the Ontario Railway Municipal Board on February 1st, 1918, follows:—

Ford City	$65,300
Walkerville	18,600
Windsor	26,200
Sandwich	25,334
Sandwich West	28,333
Ojibway	46,533
	$210,300

In March 1918, the electors by a vote of seven to one declared themselves in favor of proceeding with the work embraced in the foregoing recommendations.

Tenders were called on the eastern section from Pellette Road to Parent Ave. and known as the east interceptor, on July 22, 1918, the lowest tender being $163,573.40. The bids were so much above the estimated cost of the work and market conditions were so uncertain due to the war that all bids were rejected and re-advertised on "cost plus a fixed fee on a sliding scale." Messrs. Merlo, Merlo & Ray were the low bidders, their tender of $108,642.80 plus a profit fee of $12,000 being accepted and the contract was signed on September 24.

Work was commenced on October 17, 1918 just west of Devonshire Road and official notice of completion was received July 14, 1919, the total intervening time being 267 days. Deducting 48-1/4 days not worked, classified as follows: Sundays 38, Armistice 2, Christmas 1, rain 7-1/4, there remained 218-3/4 days. As the total length of sewer laid was 12,551 ft., the daily average of completed work was 57 feet.

As this work was done under the plan of actual cost, it was necessary that the engineers keep an exact record of every item of expenditure that entered into the work. These costs are classified naturally under these three main headings, labor, material and equipment costs:

Labor	$69,664.10
Material	35,372.26
Equipment	6,409.23
Workmens compensation	3,066.16
Profits	11,302.12
Bond	600.00
Office Expenses	882.00
Total amount of contract	$127,295.87

In order to avoid raising all the sewage of Windsor to a great height and as a corollary to this to avoid excessive depth of excavation across Windsor's waterfront, a sewage pumping station was constructed at Walkervi le which lifts the sewage 18 feet. By means of meters installed in this structure and at the boundry between Ford and Walkerville a record is available of the actual flow of sewage from each of these municipalities. The operating costs of Walkerville pumping station are in direct proportion to the quantity of sewage from each municipality. As the design of the east interceptor was of sufficient capacity to carry the sewage flow of Ford City and Walkerville for ultimate conditions, that is, when both municipalities would be completely built up, this pumping station was designed on the same basis but only sufficient pumping units were placed for the present flow, additional units to be added as the flow demands.

Tenders for the construction of the Walkerville Pumping Station were called on August 12, 1919, and the contract was awarded to R. Wescott & Co. Work was begun on September 12, 1919, and the station was placed in operation on April 7, 1920, the entire sewage flow from Walkerville being turned into the east interceptor on the following day. The total amount of this contract was $19,302.14.

Some idea of the amount of sewage pumped may be gained by a realization that the quantity pumped annually is equal to the entire flow of the River Detroit for ten minutes past and one point or that it would cover the towns of Ford City and Walkerville without their recently annexed areas to a depth of 2-1/2 feet.

Ford City Connections

Owing to the absence of complete records regarding the location of existing sewers and drains in Ford City, connections between existing sewers and the east interceptor were not provided for in the general contract of September, 1918. In the meantime, more information was secured and plans were prepared for connection on the following streets in Ford City—Jenkins Lane, Drouillard Rd., Cadillac St., Belle Isle Ave., Strabane Ave. and Rossini Blvd. Tenders for this work were received on November 27, 1919, but the bids were rejected and re-advertised for December 15, 1919. The contract was awarded to Merlo, Merlo & Ray on December 29. Work was commenced on January 7, 1920 and final settlement was made with the contractors on May 27, 1920. The total amount of this work under this contract was $6,397.39.

With this work completed, the Commission had carried out the first recommendation in the joint report. All the sewage from Ford and Walkerville was now being delivered below the intakes of both water works stations and nine sewage outlets were eliminated.

South Interceptor

The south interceptor extends from Fourteenth St. in Ojibway, follows Main, Sandwich and Russell Sts., to Park St., in Sandwich and is 12,930 ft. long. It was designed to care for the domestic flow from Ojibway, Sandwich West and the southerly half of Sandwhich. The sewage of Ojibway will be received at a pumping station to be constructed near Thirteenth St., by the city of Ojibway and will be raised and delivered to the interceptor at this point.

Tenders for the construction of the south interceptor were called on October 16th, 1918. The tender of the Shand Engineering Co., was believed to be much too low and after a conference between members of the Commission and Mr. Shand, the contract was signed by the Shand Engineering Co., to perform the work for $115,000. Construction was started on February 11, 1919 on Russel St., near Park St. and on October 10, when about 33% of the pipe had been laid an assignment was made by the contractor. At this time he had expended $116,433.00 and the value of the work for which he was paid amounted to $49,207.35.

To avoid loss of time, the work was again advertised on the basis of a lump sum price to complete the work. All bids were rejected after a report on the bids by the Commission's engineer and the tendering contractors were asked to submit a bid on a "cost plus basis." Formal bids at large were again called on January 16, 1920, and the contract was awarded to the Border Cities Construction Co.

Construction was begun on February 11, 1920 and the last length of pipe was laid on December 17. Much of this construction was through quick sand and was all open cut work differing in this respect from the east interceptor. After the completion of pipe laying, sundry repairs and replacements on the Shand contract together with cleaning out the whole pipe line were necessary . On the recommendation of the engineer, the contract with the Border Cities Construction Co., was terminated on May 1, 1920, due to their high overhead expense and the work was completed under the direct supervision of the Commission's engineer. The total cost of the work under the contract was $93,933.55.

Park St. Pumping Station

Until such time as the centre interceptor is constructed across the water front of Windsor and Sandwich, the Park Street pumping station provides a temporary outlet for the south interceptor by pumping the sewage into the existing Park St. sewer and will be abandoned when this work is completed.

Tenders were called for the construction of this station on February 14, 1920 and the contract was awarded to Merlo, Merlo & Ray. This station cost $18,029.01 and final settlement was made with the contractors on October 28, 1921.

With the completion of the Park St. pumping station, the work embraced in the two recommendations in the report on sewage disposal had been completed. What had been accomplished? All the sewage from the towns of Walkerville and Ford City was being carried below the intakes of the Windsor and Walkerville pumping stations, nine objectionable sewage outlets had been eliminated and the river front for a length of five miles had been freed from further domestic sewage pollution. The International Joint Commission will sooner or later exercise its power to forbid all pollution of boundary waters. With the completion of the interceptor across Windsor's waterfront and a portion of Sandwich, the order will have been complied with insofar as it affects the Essex Border District.

We have received from the Toronto office of the Dominion Bridge Company, a copy of their current stock list, of steel shapes and other metal products for immediate shipment. The booklet contains several pages of weights, safe loads for beams, channels, angles, etc., and general information. They will be pleased to forward you a copy on request.

The Prince Edward Hotel, Windsor

Details of a Recently Completed Building, Which Includes Several Important Structural Features—Design of the Steel Frame and Floors

The site of the building has a frontage of 161 ft. 4 in. on Park Street and 89 ft. 10½ in. on Ouelette Avenue, the two streets intersecting at an angle of a little over 97 deg. While the hotel is designed for fourteen storeys, only ten are completed at the present time. The dormitory, which is located on the roof, and the pent houses are 162 ft. above grade, with a basement 18 ft. below grade. The hotel contains two hundred and forty-two bedrooms, each with a bath.

General Characteristics

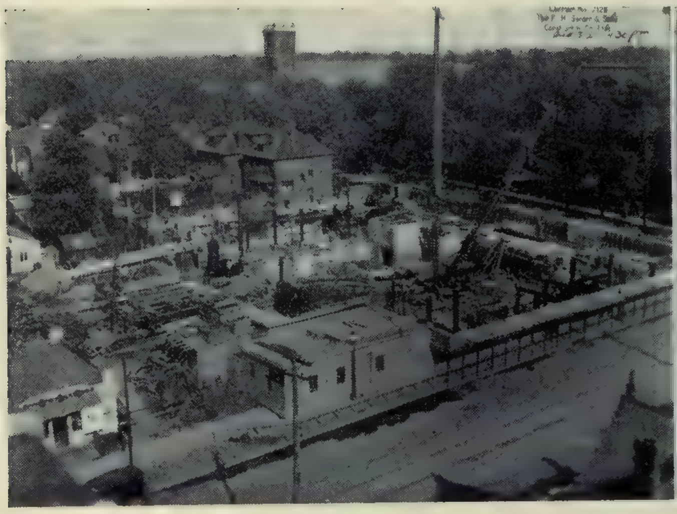
The frame of the Prince Edward building is of structural steel, while the floors are of the solid concrete slab type. The spandrel walls are of 8-in. interlocking tile with one course of face brick. Gypsum block partitions are generally used. It was not practicable to sink caissons, on account of the depth of rock in this locality. The soil, however, was found to be a very good clay, and spread concrete footings were considered suitable, the load being transmitted to the footings by two tiers of grillages. The steel columns rest on the exterior wall at grade level. The advantages of this procedure are a saving in structural steel amounting to a number of the heaviest column sections in the building, and a saving in time of the total construction of the building since the foundations may be continued and the exterior walls poured during the time the steel work is being fabricated.

Steel Frame

The floor framing of the structural steel consisted mainly of 12-in. I-beams framing directly into the columns, which were arranged in the architectural lay-out so that they would coincide, as far as possible, with the partition lines. In this way it is only necessary for the spandrel beams to be sufficiently strong to carry the wall, consisting of 7-in., 15-lb. I-beams with 8-in. by ¼-in. plates on the top of the beam; the edge of the plate being 2-in. from the face of the wall and the centre line of the I-beams 7½ in. from the face of the wall.

In order to provide for the additional three floors

The Prince Edward Hotel, Windsor


Progress view on August 3, 1921

Excavating on May 26, 1921

for which the building is designed, all steel beams above the main roof elevation which do no occur at the level of these future floors, have bolted connections and provision has been made on the columns to carry these beams when the other floors are added.

A suspended ceiling is used over the entire sixth typical floor. This consists of 4 in. at 5¼-lb. channels spaced 4 ft. back to back, and hung by 5/8-in. round rod hangers, spaced approximately 6 ft. apart. The ceiling is fastened to the channels which are designed of sufficient strength to carry plank runways for use in connection with the pipe space which occurs between the suspended ceiling and the roof, a distance of 6½ ft.

The columns, made of built-up sections of angles and plates with flange plates added for the heavier columns, are spliced every other floor. They were designed for the full live-load on the roof (on the fourteen storey basis) and on the three floors immediately below. The live load on the lower floor was reduced by 5% per floor of all the live load above in the usual manner until 50% of the live load is reached, continuing from this at 50%.

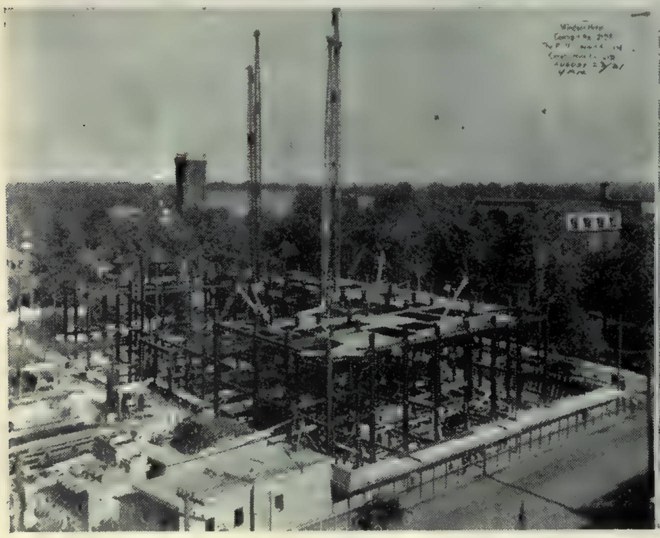
Floor Construction

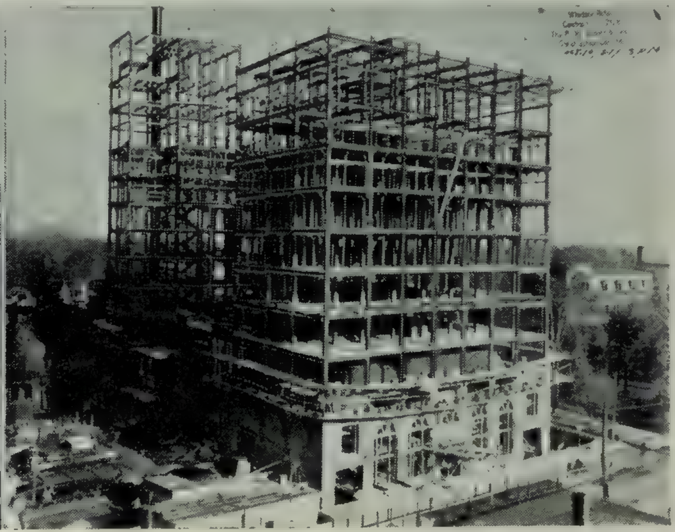
In the floor construction, a flat ceiling effect was accomplished by placing the beams approximately 12 ft. on centres, and to coincide as far as possible with the room partitions. The span was bridged by a solid concrete slab, which gave the flat ceiling effect and in this particular case also proved economical, both in the cost of the floor and also indirectly in the saving in the total height of the building from that which would have been necessary by the use of a joint system of floors involving greater depth per floor In view of the difficulty of getting anthracite cinders, stone concrete was adopted.

There are eleven floor slabs, including the main roof which is designed as a floor, and the dormitory and pent house roofs. The reinforcement used in the slabs consisted largely of ½-in. and ⅜-in. plain, square and round bars. The top of the structural steel beams are 3-in. below the top of the slabs to allow one-half of the reinforcing steel to run over the beams in order to give continuous action in the slabs. All structural steel floor members are fireproofed with concrete poured with the slabs. The columns, however, are fireproofed with 2-in. terra cotta.

The erection of the steelwork, by the Canadian Bridge Co., was done with two stiff-leg derricks which were so placed that all portions of the building could be reached by one or the other of the derricks. After the steel for the first two floors above had been placed four floors were erected at one lift.

(Continued on page 749)


The state of the steel frame on August 23, 1921


A month and a half later

The Essex Border Municipalities

Windsor, Walkerville, Ford, Sandwich, Ojibway, Riverside, Tecumseh

In recognition of the wonderful industrial advantages and possibilities and the tremendous constructional activity in those municipalities in Ontario along the Detroit River, known as the Border Cities, this district is featured in the present issue of the "Contract Record." The so-called Border Cities include Ojibway, Sandwich, Windsor, Walkerville, Ford and the more recently incorporated Riverside and Tecumseh—seven municipalities, merging one into the other along a ten-mile waterfront and including between them well over 60,000 people. These towns occupy a unique place in the story of the industrial development of Canada, for there may be attributed to the Border Cities a large part of our trade expansion in recent years. Admirably situated both as regards raw material and finished products' markets, they have experienced an industrial growth quite unprecedented in the history of Canadian municipal development. The consequence has been that the population has grown by leaps and bounds, indeed to an extent far surpassing all other cities of Canada. Official census statistics indicate an increase of 116.17 and 113.2 per cent. in the population of Windsor and Walkerville respectively between 1911 and 1921. In five years alone the number of residents in all the Border Cities has increased 60 per cent.—from 38,469 in 1916 to 61,422 in 1921.

In every department of city life these cities have developed with an impetus fostered by their strategic location, by their splendid rail and water transport facilities and by their proximity to Detroit, one of the great United States industrial centres. In this growth the contractor, engineer and architect have had an important part, for it has been their duty to plan and build factories, warehouses, stores and houses that have been involved in the great development. Just how extensive building operations have been carried on may be demonstrated by pointing out that the Border Cities stood last year the third place in Canada in point of building permits issued.

Because the Border Cities have grown so rapidly, it must not be supposed that it is any mushroom development that has been taking place. On the contrary, there is every reason for the belief that stability and permanence have marked the expansion that has taken place. The industries that have established themselves in the district are all enjoying good business, with prospects that ensure a continuance of splendid trade conditions. The fact that population and the employment pay rolls have grown consistently is a further indication of the permanence of the development.

What the possibilities of industrial and commercial expansion in this section of Ontario are is almost beyond power of words to forecast. Evidences of prosperity are noticeable on every hand and many great developments are promised for the near future. Reference is made to these in later pages. On the whole, therefore, the growth and success of these Border Cities are assured. In recognition of this and of the part the construction industry will play in these developments, this special issue of the "Contract Record" is issued. While it does not claim to be a complete record of Border Cities' activities, it at least gives our readers an insight into a part of Canada that is fraught with wonderful possibilities.

A Great City in the Making

Growth of the Essex Border Municipalities

The Most Rapidly Developing Centre in Canada—Two Hundred and Eighteen Industries—Millions of Dollars to be Spent

By F. MACLURE SCLANDERS, F.R.G.S.
Industrial Commissioner, Border Chamber of Commerce

The Border Cities comprise the municipalities of Riverside, Ford, Walkerville, Windsor, Sandwich and Ojibway, all of which adjoin without severance. Strangers cannot tell where the one ends and the other commences. They are located, as is generally known, at the southern extremity of Canada, on the Detroit River, just opposite and only eight hundred yards from the City of Detroit.

Buildings of the Border Cities

The Bartlet office building Windsor, constructed by the John V. Gray Construction Co., and designed by J. C. Pennington

To assert that the Border Cities are the most rapidly expanding communities in all Canada, is entirely within the limit of fact. Their development is peculiarly reminiscent of that which, during the Western boom period of 1910 to 1912, raised modern cities on the bald, raw prairie as though at the touch of a wizard's wand. There is this material difference, however: The development of the Border Cities owes nothing to realty hysteria. On the contrary, it is based upon the safest, most substantial of all foundations—industry.

Five years ago, the Border Cities possessed one hundred and thirty two industries: To-day, there are two hundred and eighteen;— Many of them large and otherwise important.

Some concise conception of the weird unfolding of these municipalities may be grasped from the fact that their population—now considerably over 62,000—has practically doubled within the lifetime of a child not yet ready for kindergarten.

Of course, such development involves much building;—and, much building there certainly has been. Miles upon miles of new streets have been opened up, paved, boulevarded, fringed with young trees and lined on both sides with brand new homes, all occupied by their owners or tenants. And, today, standing behind the Border Cities, and looking toward Detroit—which by the way, is to the north,—one is amazed at the number of new buildings now in process of erection. An extraordinary transformation is taking place with weird rapidity. Behold, a great city in the making.

Even the larger centres of the further east are, at last somewhat reluctantly admitting that things really are happening here. Within the past couple of years they have reached the point of admitting, under pressure, that the Border Cities are no longer the mere jumping off point on the trip to Detroit.

Buildings of the Border Cities

Main office of the Walkerville Land & Building Co., designed and supervised by Albert Kahn, and erected by the John V. Gray Construction Co.

Only a few years more, and the Border Cities—or whatever they may be ultimately named—will be given in the geography books of our school children as one of the truly great cities of the Dominion. Do not deem the foregoing the irresponsible utterance of a mere professional booster. In fifteen years of this work, I have always sedulously understated every published statement. However, everything is here to be seen. Come and see; then judge for yourself.

As already indicated, the transformation so conspicious here is wholly due to industrial development. This development emanates almost entirely from the United States. Manufacturers there recognize our propinquity to their American headquarters. They also realize the remarkable buying power of the people of Canada. During 1920, Canada's imports from the United States achieved the staggering total value of $856,176,820. Last year, they declined to $542,322,967. On these importations the duty and the exchange amounted to an enormous sum. Obviously, Canada offers a remarkable field for the American manufacturer. In addition to her domestic market of eight and three-quarter million prosperous people, many British overseas markets can be exploited to much greater advantage from Canada than from the United States. This, owing to tariff preferentials which such markets mostly grant to Canada. As a matter of fact, certain United States concerns now handle their entire export business from their Canadian branches,—for instance, the General Motors Corporation. Their parts are made here and assembled and shipped from Oshawa.

Only in a small measure is the industrial expansion of these communities due to the capital and enterprise of our own country. And, yet, in all the British Empire, there is no place more truly British.

It is probably because most of our development has its source in the United States, that our brethern further east should awaken somewhat slowly to the fact that, within a few years, the Border Cities have literally leapt from the town catagory into the truly metropolitan. American capital and enterprise is swiftly building a great city here— in Canada. Rather an interesting circumstance, is it not?

And, there does not seem to be the slightest sign of any cessation in our unfolding. It is precisely the reverse; the bigger we get, the quicker we grow. Today our outlook for new industries and business concerns is vastly brighter than it has ever been. Before long, we shall probably make certain announcements very gratifying to those who are alive to the economic importance of industrial development in this young country. The recent decision of the Ford Motor Company of Canada, at Ford, to practically double up their present plant at a cost of about $[illegible] and mean more to the Border Cities than can well be estimated at this time. At present, we have four large automobile manufacturers; but, we have forty-six other concerns making parts, etc., for the auto industry. Upon many of these the Ford expansions will be reflected. In addition, new concerns will, doubtless, be attracted. However, we are not counting our chickens ere they are hatched: we are not worrying about our potential development. It is taking us all our time looking after the actual end of things.

It may be interesting to add that, for the past five years especially, local manufacturers have intelligently and energetically devoted their attention to export trade. They will tell you today that, after all, export business is by no means, the forbiddingly difficult matter that many seem to believe. They have done well. They are encouraged to do still better. While definite figures are not yet completed, it seems safe to state that last year's exports from the Border Cities would reach a value of fully $25,000,000. Had Canada a greater export trade she would suffer only a negligible unemployment during winter. Too many Canadian manufacturers who ought to be exporting remain complacently contented with their highly protected domestic market.

It is not the purpose to load this article with figures. Better to give facts from which figures may be assumed. This has been done in a sense sufficient for any thoughtful business man.

In conclusion, let me say quite sincerely, that I find it very hard to write of what is taking place here. It is all so wonderful that even a deliberate understatement of facts may be so readily constructed as exaggeration demanding a drastic discounting or entire discredit.

However, things are here to be seen; and, we have now one of the finest hotels in the country for the accommodation of our visitors. Our citizens built it at a cost of $2,000,000, every cent of which was paid when the hotel opened on 6th June.

At this southern extremity of Canada, a great city is arising with amazing rapidity;—a city which, within comparatively few years, will take her undisputed place among the truly great metroplitan centres of the Dominion.

Border Cities Third in Canada in Point of Building Permits

Building records for the first five months of this year (the latest available) place Windsor fifth among Canadian cities in point of building permits issued. The figures are: Toronto, $13,500,745; Montreal, $6,583,797; Winnipeg, $2,800,700; Hamilton, $2,336,140 and Windsor $2,034,185. In the year 1921 Windsor did even better and supplanted Hamilton in the fourth place, Windsor issuing permits to the value of $5,123,150. It is a most remarkable record for a city of 40,000 population to occupy fourth place in Canada and is proof positive of the statement that building conditions are as favorable in the Border Cities as in any part of Canada. We have taken Windsor in reciting these figures, because authoritative records are more readily available, but an investigation of the building situation in the entire Border district shows that the other municipalities are just as active in proportion and that, in fact, the combined Border cities occupy third place among Canadian cities. Last year the total permits for all the Border municipalities was $6,339,610, a figure surpassed by only Toronto and Montreal.

In Windsor building has been very active and has been progressing at a rapid rate. The Prince Edward hotel is completed and was opened about a month ago and while this marks the end of the largest building contract in the history of the Border cities, other large jobs are under way. The Victoria, Prince Edward and St. Clare schools were finished not so very long ago. Two new theatres, extension to the Grace Hospital and new police headquarters building were put into commission, while there were innumerable other buildings of an industrial and business character constructed during the past year. Some of these are more specifically referred to elsewhere in this issue. At the present time housing construction is very active and in all parts of the city new residences may be seen in course of erection. It must not be supposed, however, that Windsor, although the largest municipality, is monopolizing all the construction, as Sandwich, Walkerville and Ford all show satisfactory reports.

Building activity in Walkerville is steadily progressing. Five large contracts are now being completed, aggregating an expenditure of several hundred thousand dollars; in fact near the million mark. These are the Walkerville high school, costing more than half a million; the new Bell Telephone building at the corner of Huron and Erie streets, $60,000; the Walkerville Hydro-Electric Commission building ,$60,000; Pickard's drug store block, Wyandotte St. $35,000; Kaplan's block, Wyandotte Street, near corner of Moy Avenue, $40,000.

Buildings of the Border Cities

Warehouse of the Eaton Clarke Co., built by the John V. Gray Construction Co.

In addition to the above, a considerable number of private homes are under construction and permits have been taken out for others, the work to be completed by fall. Workmen in the building trades in Walkerville have all they can do.

The construction of the new Hydro-electric commission building, Argyle road and Wyandotte street, is rapidly nearing completion. This will be one of the handsomest retail blocks in the Border Cities, and will be used in its entirety for sales purposes of the Walkerville Hydro-electric Commission. Second floor work on this building is now well under way.

On the new Pickard block, Wyandotte street, the contractors are making good headway. The basement work is nearly completed, and first floor superstructure is well under way.

The Kaplan Block, nearly opposite Weingarten's Department store, is the first building to be erected on a considerable north frontage of Wyandotte street between Moy Avenue, Windsor and Gladstone Ave., Walkerville. This block will also be a handsome addition to the street.

In both Sandwich and Ford housing is the big item and almost every day it is possible to see a start made on new residences.

Border Cities' residents are very enthusiastic about prospects in their locality and there seems to be quite a current of optimism, based partly on the faith in the district and partly on the more tangible programs that have been announced by certain industries.

The extent of these and the effect they have is well expressed in an editorial in the Border City Star, which we quote as follows:

"The statement of Mr. Wallace R. Campbell, vice-president and treasurer of the Ford Motor Company of Canada, Limited, that his company is planning an early start on a new 125-acre plant to cost in the neighborhood of $6,000,000 is one of the most outstanding announcements that has come in the industrial history of the Border Cities. It is an exceedingly encouraging indication of bright prospects for this district, and shows the supreme faith in future industrial awakening on the part of industrial leaders.

"Another most interesting development was the announcement that the Dodge Brothers organization would locate a branch plant here for the construction of cars for the Canadian and British Empire trade is also of great import. Definite decision to this end has been made. The Star is informed, various sites have been considered and an official announcement will be forthcoming at once. What this will mean to the future of the Border Cities must be apparent to all. The Dodge organization is one of the largest and strongest in the automobile world today. Its product is being shipped to every corner of the earth. For some time officers of the company have been considering the erection of a Canadian plant. Various centres have angled for this industrial plum. Deputations have gone to Detroit to urge the claims of their respective municipalities. No doubt these representations have been carefully considered. The result is the decision to build in the Border Cities—the logical location for the American motor car manufacturer who wishes to operate a Canadian branch.

"Only a short time ago, the Reo Motor Company of Lansing came to the same conclusion, with the result that the Canadian headquarters of this large industry were changed from St. Catharines to Windsor.

"The coming of the Dodge Brothers organization is important in more ways than one. It furnishes additional proof of the growing importance of Canadian and British trade in the eyes of American manufacturers and once more it places the seal of approval upon the Border Cities as the motor manufacturing centre of the Dominion.

"These announcements concerning, as they do, two of the world's greatest industrial organizations, and coupled, as they are, with a general belief that outstanding developments in Ojibway are not far off, should give a renewed impetus to business all over the province and, for that matter, over the Dominion. When far-seeing organizations, such as Ford and Dodge, prepare to spend huge sums in expansion work, the result must be to give confidence to the country as a whole. Depression days have passed. We are on the high road to solid and lasting prosperity."

Essex Border Utilities Commission

Representative of All the Municipalities, It Has for Its Object the Solution of Problems Which Affect the Whole District as Distinct from Those Which Affect Any One of the Towns in Particular

By J. CLARK KEITH

Chief Engineer, Essex Border Utilities Commission

In 1914 the International Joint Commission under the terms of the treaty of January 11, 1909, between the governments of the United States and Great Britian issued their first progress report with reference to the question "To what extent and by what causes and in what localities have the boundary waters between the United States and Canada been polluted so as to be injurious to public health and unfit for domestic or other uses?" This report stated, based on the results of two thousand analyses, that the entire Detroit River was avoidably polluted by the municipalities of Windsor, Walkerville, Sandwich and Amherstburg and across the international boundary by the cities of Detroit, Wyandotte and Trenton. It further stated that "the water intakes of Walkerville and Windsor were both located in dangerous situations owing to the discharge of sewage above those intakes and to the danger due to navigation."

In 1916, a second report was published dealing with remedial measures with reference to a second question: "In what way is it possible and advisable to remedy or prevent the pollution of these waters on either side to the injury of health or property on the other?" This report deals at length with the pollution of the Detroit River, traversing as it does, the most densely populated district on any of the boundary waters. In dealing with the sewage problem as applied to the city of Detroit, to which a parallel condition was found on the Canadian shore, the report stated in part: "As long as the various municipalities continue to act independently in solving their sewage problems, it seems certain that there will be friction between them and duplication of effort due to lack of co-operation in planning for future needs. In consequence of the fact that this section is developing and increasing in population very rapidly, it would be illogical to confine a study of the future sewage problem of the district to the area now within the corporate limits and would be fruitless of concrete results.

The establishment of a logical drainage district would be advantageous in

(1) Preventing disputes between the various interested communities.

(2) Effecting economies and producing more satisfactory conditions generally by comprehensive planning.

Formation of the Commission

The need of joint effort was realized but the method of accomplishment was not apparent for some time. In the fall of 1915 a conference was held by representatives of the several Border Municipalities to discuss questions of transportation, then as now, of pressing and increasing importance. At this meeting it was resolved that "it would be a great advantage to Windsor, Walkerville, Sandwich and other adjoining municipalities to have a Joint Commission to act in matters relating to street railway service, sewage, hydro-electric and water systems in which the municipalities have a common interest."

As the outcome of this meeting, an application was made in February 1916, to the Ontario Legislature for a bill giving certain definite powers to a Joint Commission to deal with the utilities mentioned.

Objects of the Commission

The Essex Border Utilities Commission was constituted by a special act of legislature in April 1916, on the request of the rapidly growing municipalities along the Essex Border which had common problems and which could not satisfactorily be considered by the municipalities individually both because the law did not provide a means of the councils joining together to solve them and because the problems were of such a nature that it would involve a waste of public money if they had to be solved by the municipalities acting independently. The Commission therefore had for its object the solution of problems which necessarily affect the whole of the Border Municipalities as distinct from those affecting any one of them in particular and the original powers and those obtained from time to time have been upon request from representative bodies of men elected by the people or chosen by several councils.

The water and sewage problems were taken over at the request of bodies named by the councils representing all the municipalities which assembled originally to deal with problems of transportation; the local board of health and hospitals at the request of the greater majority of the councils and of all the local boards of health; the power of a board of park commissioners at the request of the municipalities having parks within their corporate limits and those of a town planning commission by representative bodies of citizens, who with vision, had reason to believe that foresight exercised now would avoid expensive corrective measures at a later time. Constituted originally to handle questions largely engineering in character, which were, however, interlocked with problems of a varied nature, the Commission is now by external request in a position to deal with questions which involve the health as well as social and economic problems of the district as a whole

Personnel

The Commission was organized in June 1916, in accordance with the Act. Six municipalities were represented Ford, Walkerville, Windsor, Sandwich, Ojibway, and Sandwich West and each of these municipalities had two representatives on the commission, the mayor or reeve of each municipality, together with six commissioners, one appointed by each council for the balance of the current year, all serving without remuneration. The personnel of the Commission in 1917 consisted of twelve members, the chief magistrate of each municipality together with one elected commissioner from each municipality for a definite term of office—Windsor five years, Walkerville four years, Sandwich three years, Ford City two years and Ojibway and Sandwich West one year each, the next term of office to be a uniform one of five years each, thus ensuring continuity of policy. In May 1918, the number was increased to 14 members with the admission of Sandwich East. Upon the incorporation of the towns of Riverside and Tecumseh four additional members were added in June 1921, and these with three additional members from Windsor make a total of nineteen members, eleven elected and eight ex-officio members, all responsible to the vote of the electorate. By an amendment to the Act in 1920, the term of office of the elected commissioners was reduced to three years.

Contractors Have Strong Organization

In the Fourteen Years of Its Existence, the Essex County Builders' and Contractors' Association Has Manifested Its Power and Strength on Many Occasions

An association of contractors is bound to be a power for good in the community. The construction industry, as the second largest industry in the country, is worthy of greater attention than people as a rule are accustomed to give it. But to ensure its success, the industry should have the co-operation and good will of the public, which can be secured through no better agency than an organization fully representative of the contracting interests in the community. In addition, of course, such an organization secures numerous benefits for its own members that could not otherwise be obtained were the contractors not properly banded together.

George Goodman, president of the Essex County Builders' and Contractors' Association

Benefits of Organization

These two general benefits of organization—the good will of the public and improvement of the status of the industry itself—have been secured by the Builders' & Contractors' Association of Essex County, in which the leading contractors and supply men of the Border Cities hold membership. Its formation dates back to 1908, although prior to that the need was recognized for an organization where contractors and builders could get together and discuss questions of policy and details in connection with their work. Fourteen years ago, therefore, something tangible was forthcoming in the formation of the Essex County association, which was guided in its initial stages by M. A. Brian, a very well known figure in the contracting industry of the Border cities. Even a year later the organization had shown considerable signs of growth which have continued in cumulative fashion until today the association is recognized as a powerful influence in the affairs of the Border cities.

The organization has manifested its strength on numerous occasions and has frequently demonstrated its ability to maintain amicable relations between employers and employees during the disputes which have, on occasion, disturbed the industry. On occasions too numerous to mention, its efficiency has been proven and the enthusiasm of its members displayed.

In the early part of 1915, during the war, when business conditions were none too good and building was slow, the Builders' & Contractors' Association of Essex County showed its confidence in things by erecting, on Ferry St., the present home of the association where ample facilities are provided for the meeting together of the contractors of Essex County.

Present and Past Officers

The present officers of the association are: President, George Goodman, Sandwich; vice-president, Lorne Laing, Windsor; treasurer, Wm. Laesser, Windsor; secretary, H. E. Turner, Windsor.

The Secretary, H. E. Turner

The gentlemen who have occupied the presidential chair since the inauguration of the association are as follows: 1908, M. A. Brian; 1909, George Thompson; 1910, L. B. West; 1911, Frank Dumouchelle; 1912, Thomas W. Brooke; 1913, James Pennington; 1914, Charles Scott; 1915, John Reid; 1916, C. W. Cadwell; 1917, W. T. Piggott; 1918, Harry Howe; 1919, L. McGill Allen; 1920, Herbert W. Wilson; 1921, W. M. Walker; 1922, George Goodman.

The following gentlemen have been the secretaries—George W. Freeman, Robert Parker, A. J. Lossing, Charles Paddon, Percy Grimes and Harry Turner, who is the present incumbent, having been appointed last year.

The present membership is as follows: Artificial Stone—A. H. Bennett, Cast Stone Block & Machine Co., Ltd., Ford City Cement Block, M. Jacques, J. Lefebvre and E. Plant.

Builders' Supplies—Cadwell Sand & Gravel Co., Ltd.; Chick Contracting Co., C. A. Chilver Co., Ltd., Cross Bros., A. G. Hutchinson, de W. P. Waard, Walkerville Fuel & Supply Co. and George White & Son.

Cut Stone Contractors—Rigg Cut Stone Co., Ltd.

Carpenter Contractors—Allen Construction Co., Eugene Baby, J. E. Bondy, Charles Clarke, A. Dufour, William Dupuis, U. Jacques, S. Keyser & Son, M. J. McKernan, W. J. Nesbitt, Peter Osterhout, Frank Pickells, Fred Prince, J. Schneider, V. D. St. Louis, William Walker, Wharton & Wharton, C. Willis and Windsor Construction Co., Ltd.

Excravating and Paving Contractors—Cadwell Sand & Gravel Co., Ltd., Chick Contracting Co., Ltd., George S. Currie, S. E. Dinsmore Co., Ltd., Merlo, Merlo & Ray, George Shaw and S. P. West.

Electrical Contractors—G. Campeau, W. A. Lefave, McNaughton & McKay Electric Co. and F. D. Reaume.

General Contractors—Abbott & Gray, H. G. Christman Co., Ernest Clarke, Ltd., S. E. Dinsmore Co., Ltd., John V. Gray Construction Co., Ltd., P. H. Secord, Wells & Gray, Ltd. and W. E. Wood, Co., Ltd.

Building Specialties—McLaughlin Sales Co.

House Painters and Decorators—T. W. Brooke & Sons, C. M. Bennett, A. Henri, William Laesser, A. J. Lossing, H. H. Post, J. J. Roe and Windsor Glass Co.

Hardware Supplies—Baxter Hardware Co. and Canadian Roofing Co., Ltd.

Lathing—A. Wood.

Lumber Dealers—McLean Lumber Co., Walter T. Piggott Lumber Co., Walker & Sons, Windsor Lumber Co. and Williamson Construction Co.

Mantle, Tile, Lighting Fixtures—Barton Netting Co., Ltd.

Mason Contractors—William Bartolotti, G. A. Goodman, E. Hainsworth, H. Howe, Lewis Lockwood, R. Parker, G. Sewell, W. H. Thompson, W. H. Willimott and H. W. Wilson.

Metal Weather Strip—N. W. Stephens.

Plastering Contractors—J. Brown, Cormie Bros., Crawford & McGraw, O. O. Lockwood, W. E. Middleditch, J. Reid, N. Troupe and E. T. Waterman.

Sheet Metal Workers, Plumbers and Steamfitters—M. A. Brian, Philip Dresch, Edwards Plumbing Co., N. Fielding, C. E. Greenan, C. W. Jessop, Jos. L'Heureux, R. Paddon & Co., Sandwich Plumbing & Heating Co., J. C. Service, Simpson & Hicks, Charles Smith, White Plumbing & Heating Co. and Windsor Hardware Co.

Sheet Metal Workers and Roofers—H. W. Cunningham and Pennington & Laing.

Roofing Contractors—Welsh Bros.

Structural Steel—Canadian Bridge Co. and T. J. Eansor & Son.

Terrazzo Flooring—G. Bertini.

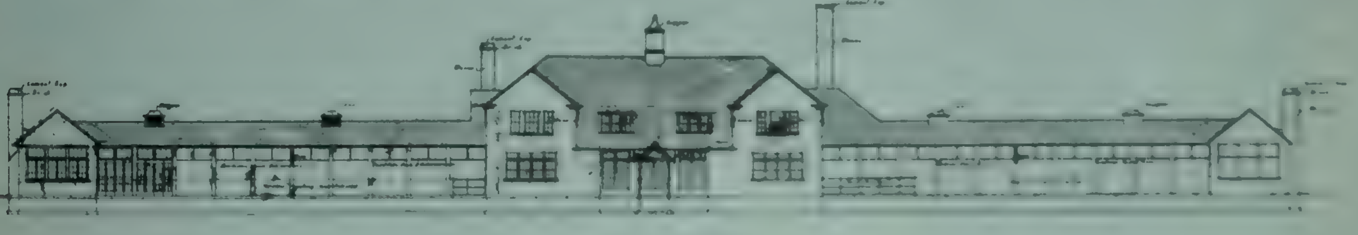
Essex County Sanitarium

The Essex County Sanitarium, is situated on Prince Road, Sandwich, on a property measuring 442' by 1,486'. The building is planned in three blocks, comprising administrative rooms and adult block, children's block and laundry block. Forty children and twenty adults will be accommodated.

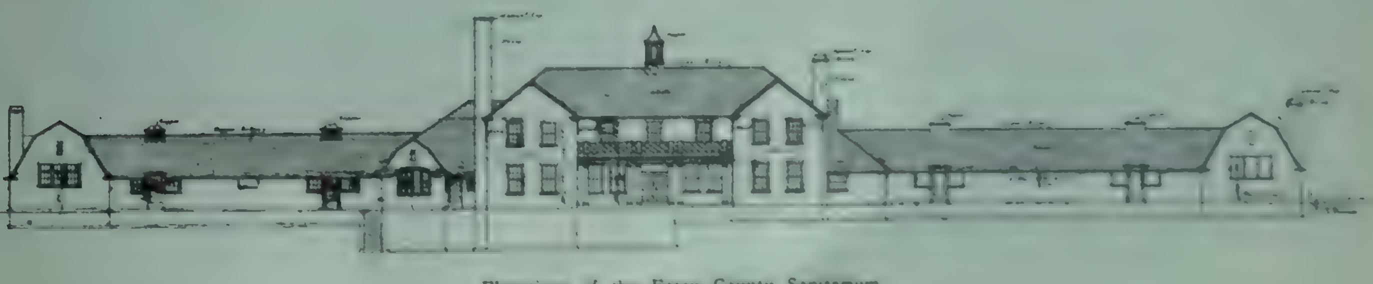
The building is of a one storey type, constructed of hollow tile with stucco finish and slate roof. The entire ground floor is of re-inforced concrete with hollow tile partitions. The main building has a frontage of 280' 0".

The contract was let to Prost, Forde & Westell of Windsor, the sum quoted being $104,800.00. The plumbing & heating is sublet to Paddon & Co., Windsor and the electrical work to Harris & Marson, Toronto.

The architects are Cameron & Ralston, Windsor. The contract will be completed about the end of September.

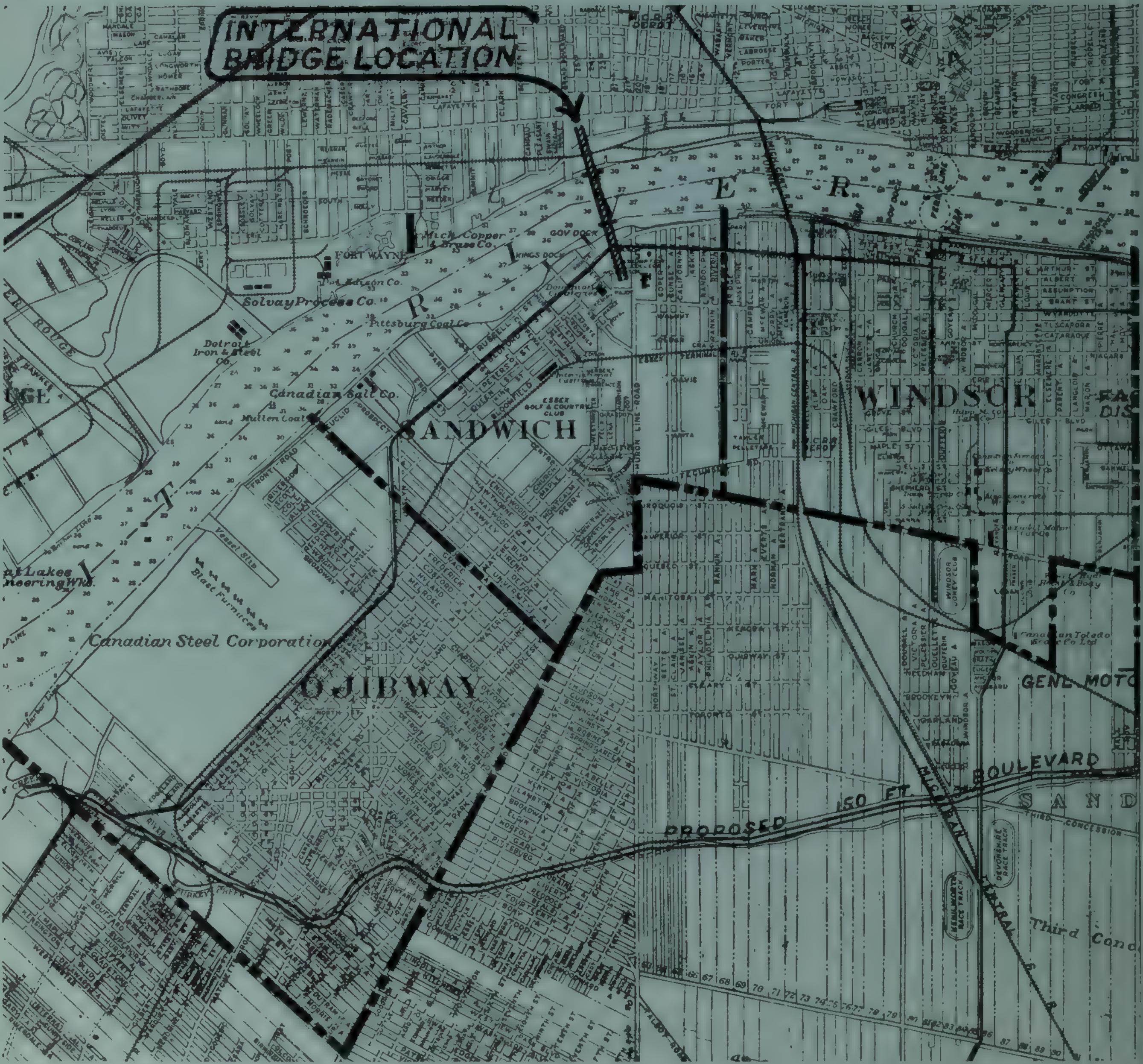


SOUTH ELEVATION



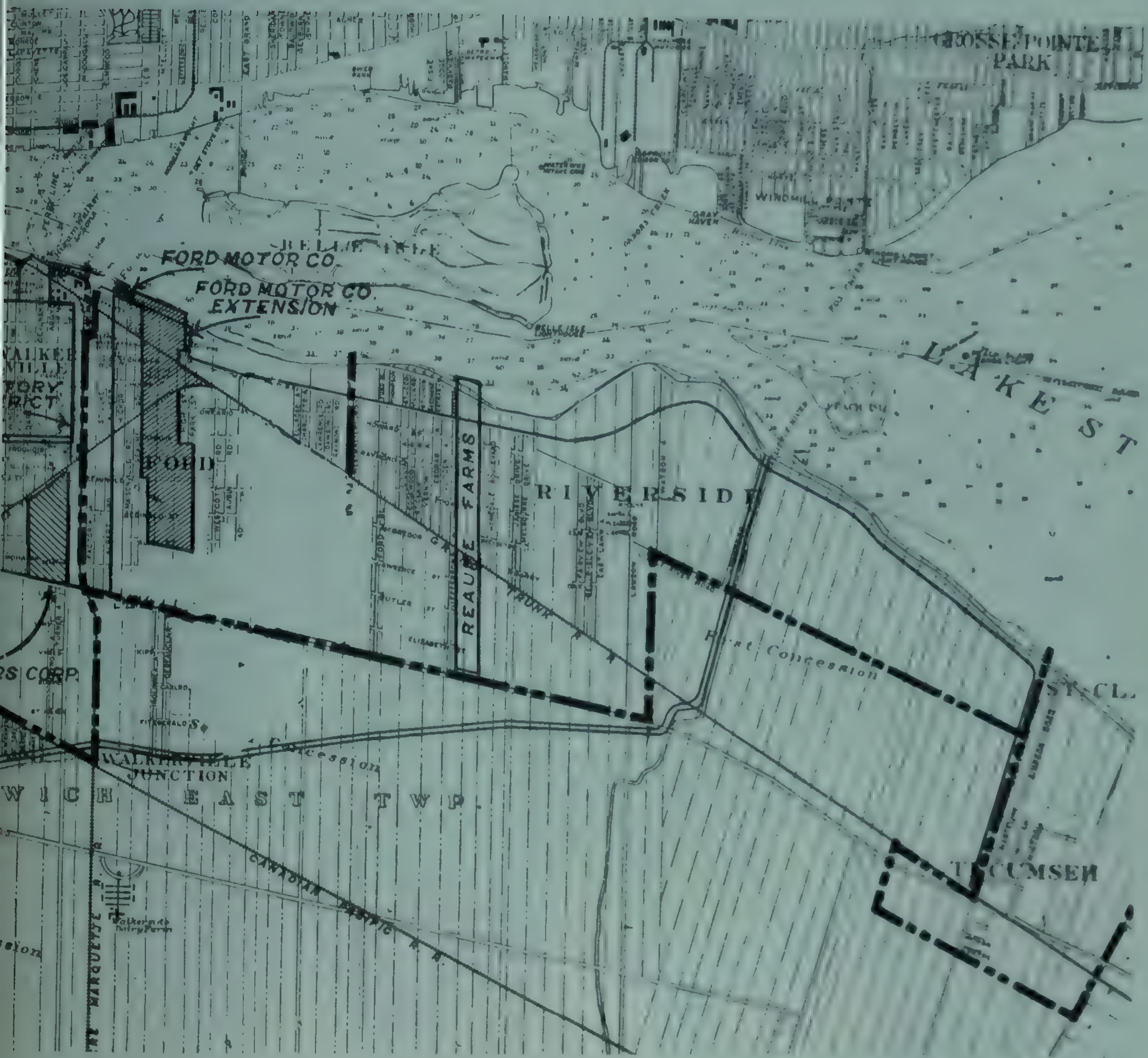
Elevations of the Essex County Sanitarium

Map of the Essex



Ojibway - Sandwich - Windsor - Ford

Border Municipalities



Walkerville - Riverside - Tecumseh

The Schools of the Border Cities

Exceptionally Fine Educational Institutions Have Been Erected in Windsor, Walkerville, Sandwich and Ford—Some of the More Recent Ones Described

If the Border Cities excel in anything, it is certainly in the quality of the schools they erect and the provisions they make for educational opportunities. All of the municipalities have shown themselves anxious to install educational facilities in keeping with the growth in population and furthermore, they have undertaken to handle this matter by erecting the best buildings that could be designed—schools that are handsome in exterior and interior and calculated to make school life pleasant for the young folks. At the same time, most of the schools have been designed as community centres and there are auditoriums, gymnasia and other features that bring not only the boys and girls, but also the parents together and create among them a strong community spirit.

It is not our intention to describe every school in the Border Cities, but rather will an outline be given of some of the leading buildings of this character erected recently. Of the Public schools in the Border Cities, the Victoria and Prince Edward schools, in Windsor, are outstanding. The accompanying illustrations indicate how attractively these buildings have been designed and how well they are calculated to fit into the school needs of the district they serve. They have been designed by Mr. A. H. McPhail, of Windsor and constructed by S. E. Dinsmore & Co. The Victoria school has 14 standard classrooms, kindergarten, auditorium, gymnasium, manual training, household science and other modern departments. The Prince Edward school is similar, but with 20 standard classrooms. In architectural design they both embody all that goes to make them artistic. Particular care has been exercised in planning the buildings for the comfort, health and welfare of the pupils, with the result that the sanitary conditions and general arrangements are all that could be desired. By an automatic system of ventilation, the air in the classrooms is changed at brief intervals, while heating and other mechanical operations are looked after in a modern, up-to-date manner.

Two other schools of particular interest are the St. Clare Separate school in Windsor and the St. Francis Separate school in Sandwich, both designed by Mr. Jacques. The former, which is at Bruce and Shepherd Streets, Windsor, contains 12 classrooms, teachers' room, music room, etc. The building which was started in April, 1921, and completed in the following December, is of modern, reinforced concrete, fireproof construction, with an exterior of red pressed brick and Indiana limestone. The finish in the basement is Kalamein and throughout the rest of the building red oak. The classrooms are floored with maple and the corridor with terrazzo. It is to the credit of the contractors, the John V. Gray Construction Co., that they completed the school several months ahead of schedule. The cost was $225,000. The St. Francis school, Sandwich, also cost about $225,000, and was altered from an old canning factory and is now a modern 14-room school with an auditorium of 750 seating capacity. This room has a complete stage and kitchen for banquet purposes. The John V. Gray Company are also contractors on this building.

The Walkerville High school is just nearing completion and will be ready for the school term next autumn. It is a very handsome building, designed under the direction of Messrs, Pennington & Boyde, architects of Windsor. The construction, which represents an outlay of nearly $800,000, was handled by S. E. Dinsmore & Co. As may be seen in one of the progress illustrations herewith, it is a most handsome building and will be one of the outstanding features of the town of Walkerville.

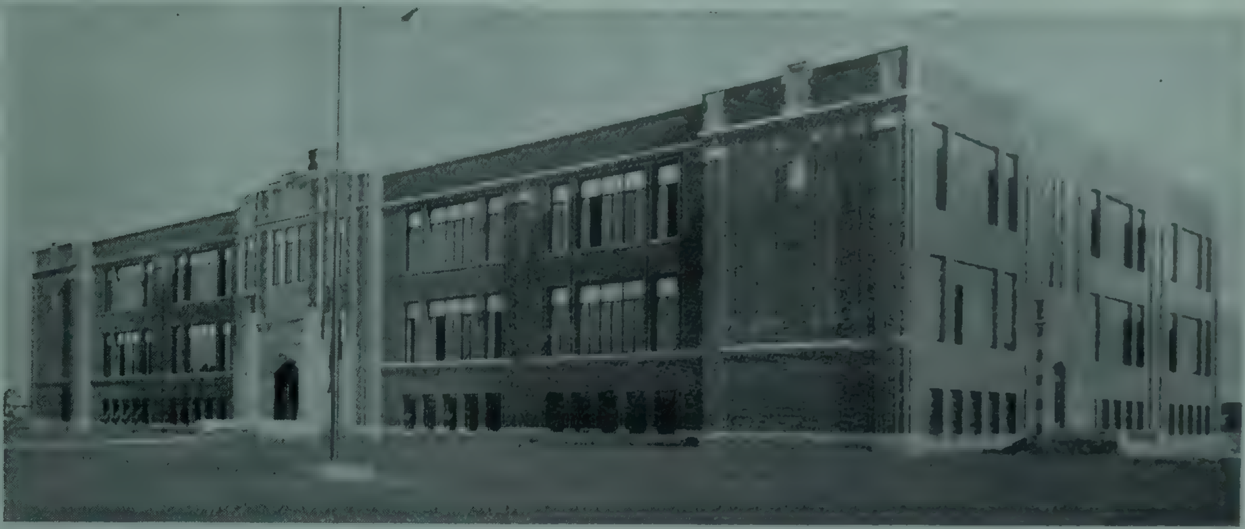
Windsor & Walkerville Technical School

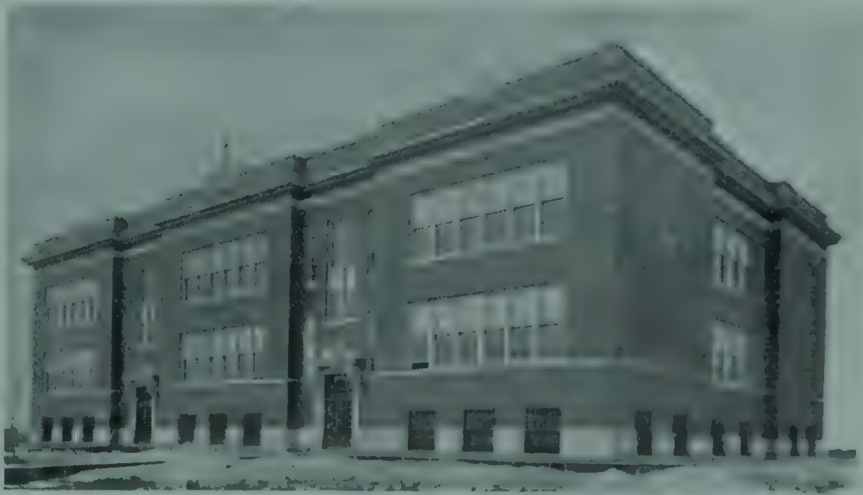
Another school devoted to higher education is the joint Windsor and Walkerville Technical school.

This school is situated on Giles Boulevard and faces due south, a site which is ideal, being central to both Windsor and Walkerville. The building has a frontage of 219′ 0″ on Giles Boulevard and 296′ 0″ on Elsmere and Parent Avenues respectively. The plan is of the 'H' type.

It is a three storey structure of brick and stone,

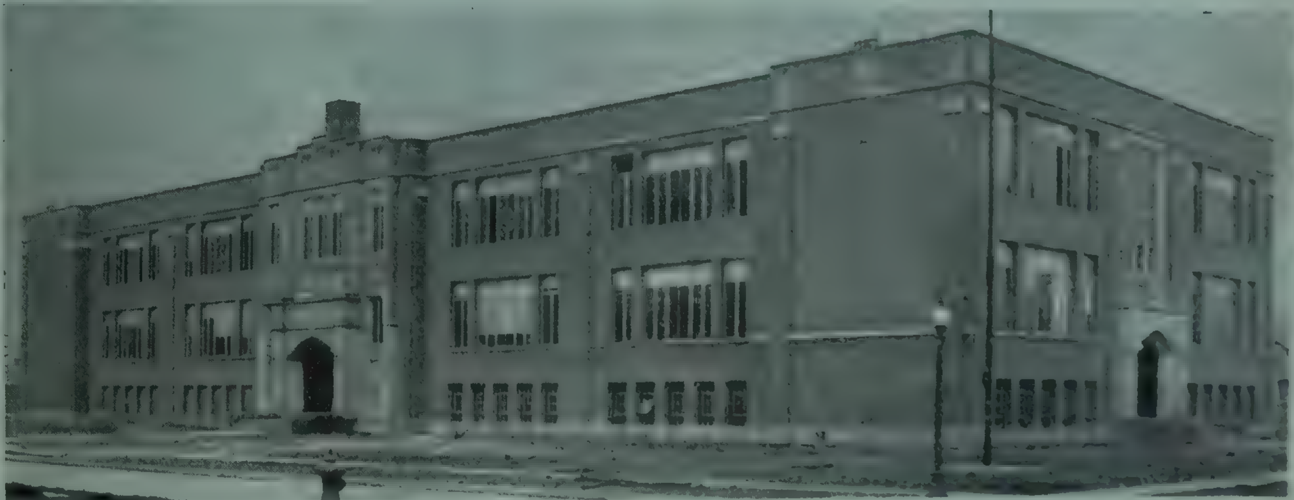
The Windsor and Walkerville Technical School in course of construction





Three New Schools in Windsor, Ont.

Above: The Prince Edward public school. **Right:** The St. Clare separate school. **Below:** The Victoria Ave., public school.



The Walkerville High School nearing completion

the construction throughout being of reinforced concrete. The first floor is on the street level, there being no basement other than that required for the boiler room, engine room, ventilating room and plenum chambers.

The building contains thirty-six class rooms in addition to the usual administrative rooms, a gymnasium, 50′ 0″ x 84′ 0″, girls' gymnasium, 36′ 0″ x 50′ 0″, auditorium to seat 700, library, locker rooms, showers, cafeteria, etc. The shops are located at the north and east of the building and occupy a total floor area of nineteen thousand feet. They comprise machine shops, tool making, heat treating, motor mechanics, electrical and plumbing departments.

Work was commenced in January and will take one year to complete. The total contracts amount to $750,000.00. The following are the contractors to whom the work is let: General trades, W. E. Wood Co., Windsor; plumbing, heating & ventilating, W. J. McGuire Co., Toronto; electrical, Miller Yorke Inc., Windsor; Engine & Generator, Goldie-McCulloch, Galt. The steel sash and reinforcing steel are being supplied by the Trussed Concrete Steel Co., Walkerville, Ont., and the structural steel by the Toronto Steel Construction Co., Toronto. The architects are Cameron & Ralston, Windsor, Ont; structural engineer, H. C. McMordie, Windsor; mechanical engineer, H. H. Angus, Toronto.

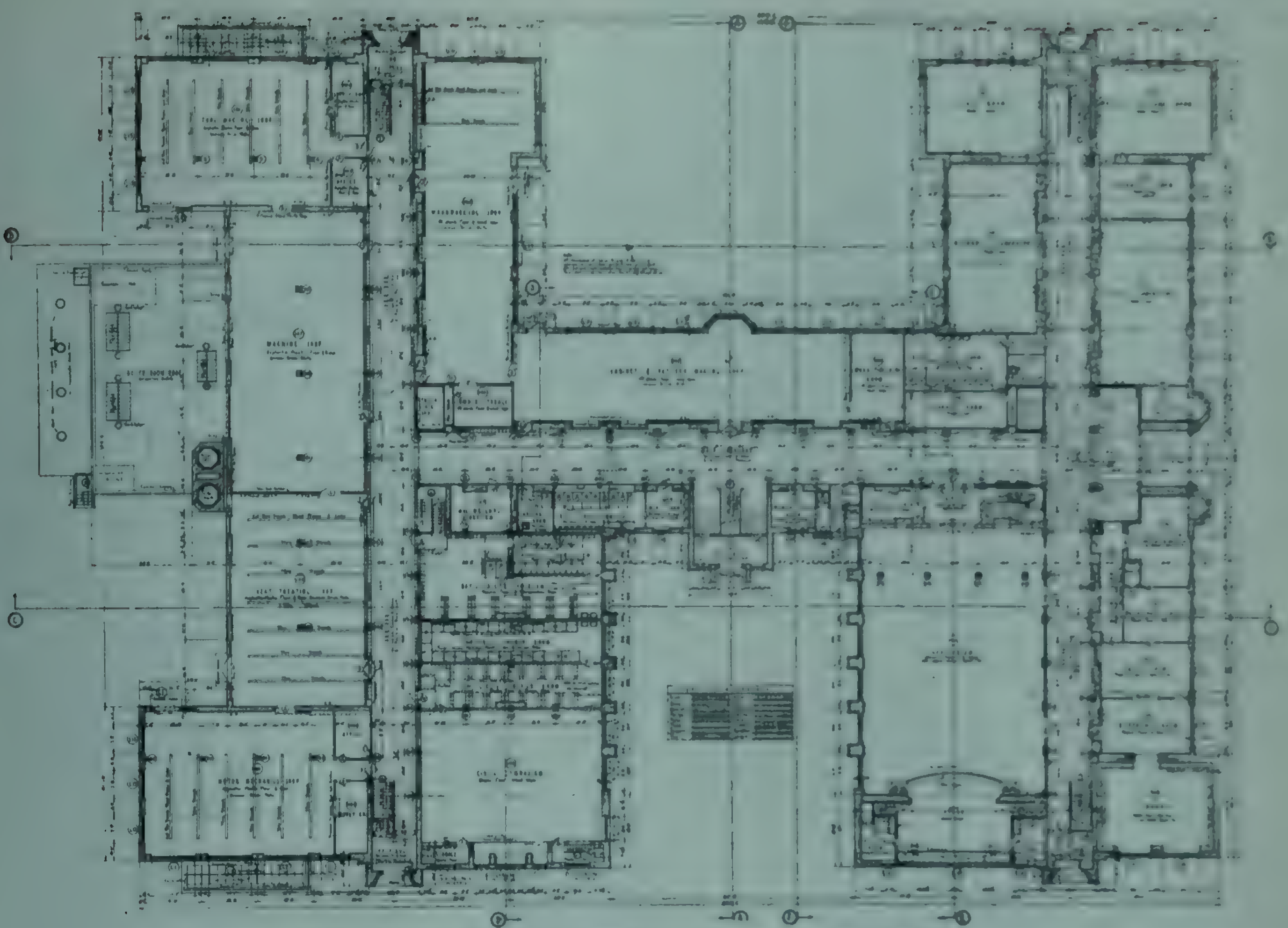
Ford City also has two schools under way at the present time, a Public school costing about $125,000, designed by A. H. McPhaill, architect, Windsor, and a Separate school, on which Pennington & Boyde are the architects. This latter school will cost about $100,000.

The public school for Ford will be the last word in this type of construction and in addition to the 8 classrooms, will include a large auditorium equipped with roomy stage and dressing rooms; gymnasium with spectators' gallery arount it, teachers' room, dental clinic, board room, and principal's room. The building is of two and three storeys, with a full area basement at grade in which are located toilets and washrooms. The general construction is face brick with stone trim and composition roofing. The building is heated by a Dunham system of steam heating and is equipped with complete and up-to-date forced air ventilating system. The interior trim is of fir, with maple floors throughout.

Two New Buildings for the Border Cities

Mr. A. H. McPhaill, architect, of Windsor, Ont., is at present engaged on the design of a new building for the Border Cities Star and an 8-room modern school for the town of Ford. The former building will be 83′ x 100′, three storeys high and will be constructed of reinforced concrete, with steel sash and metal casements. It will be located at the corner of Pitt and Fergus Streets.

The St. Francis school in Sandwich, reconstructed into a modern educational building from a canning factory



Plan of the main floor of the Windsor and Walkerville Technical School

Joint Board of Health

Border Cities Organized Into One Health District Under a Joint Health Board —Hospital Accommodation

On December 2, 1918, a resolution from the Walkerville Council was placed before the Essex Border Utilities Commission requesting its assistance in securing united co-operation in having the Border Municipalities organized into one health district under a joint health board. This resolution was endorsed by the Commission and a copy was forwarded to each municipality with the result that its desirability was affirmed by all the Local Boards of Health and by all the municipalities excepting one. In January 1920 a draft bill of application to the legislature to constitute a board of health was presented to the Commission and accepted with slight amendments.

When this application came before the legislature, it had the unqualified endorsement of the Provincial Department of Public Health. On May 16, a health committee of three members was appointed from the Commission. On June 20, F. Adams, D.P.H., was appointed Medical Officer of Health and the Local Board of Health consisting of the chairman of the Commission and Doctors Hoare, Durocher and Cruickshank was constituted in accordance with the Act.

General Hospital

In accordance with a resolution of the Local Board of Health, Dr. Adams, M.O.H. addressed the Commission on the necessity of establishing an Isolation Hospital in this district. The engineer of the Commission was instructed to prepare a report and preliminary plans together with an apportionment of the cost of the proposal recommended by the Board of Health. This report was presented and adopted on July 7, 1921. At this meeting a communication was received from the city of Windsor requesting consideration of the establishment of a general hospital for the Border District. This was referred to the Local Board of Health and on September 23 a complete report was presented to the Commission supplemented by additional figures on December 21, giving costs of operation. In view of the possibility of the construction of a general hospital, the isolation hospital was not proceeded with.

The Prince Edward Hotel

(Continued from page 736)

The associated architects for the building were Messrs. Essenwein and Johnston, Buffalo, N. Y., Messrs. Watt and Blackwell, London, Ont., and A. H. McPhaill, Windsor, Ont. The general contractors were Messrs, P. H. Secord & Sons Construction Co. Ltd. The structural steel was fabricated and erected by the Canadian Bridge Co., Ltd., of Walkerville, Ont. R. E. W. Hagarty was consulting engineer on the foundations, structural steel framework and reinforced floors.

Engineering in the Border Cities

The Activities of the Town Engineering Departments—The Municipalities Are Well Furnished with Pavements, Sidewalks and Sewers—New Projects Planned

For fourteen years the engineering department of the city of Windsor has been under the jurisdiction of M. E. Brian who is himself an old Windsor boy. Mr. Brian was born in that city in 1882 and took his engineering training at the School of Practical Science from which he graduated in 1906, taking his Bachelor of Applied Science degree at the University of Toronto a year later. Prior to his entering college he was apprenticed to and served three years with William Newman, O.L.S. In 1906 he was granted the right to practice as an Ontario Land Surveyor. For two years after his graduation, Mr. Brian was employed with Newman Brothers and J. J. Newman, engineers and land surveyors of Windsor, with whom he had also worked during some of the vacations in his college course. At the end of 1908 he became city engineer of Windsor, taking over the entire engineering responsibilities of the municipality. He previously had had some insight into the requirements of this position when he served for five months in 1904 as assistant city engineer. In the fourteen years Mr. Brian has acted in the capacity of city engineer, he has seen the population grow from 16,000 to the present 40,000, and in many other respects, the city grow by leaps and bounds.

M. E. Brian, B.A.Sc.,
City Engineer of Windsor, Ont.

The city engineer's department is responsible largely for roadways, sewers and sidewalks, there being at the present time 64 miles of pavement, 140 miles of walks and 57 miles of sewers. The city has the distinction of having a greater proportion of paved area than any other city of its size in Canada, 85 per cent. of the streets not including alleys being paved with hard surfaced roads. 1,000,000 yards of street pavement is concrete, Windsor being practically the pioneer in this type of construction. There are many concrete roads in the city that have been down for the full length of Mr. Brian's regime, and are still giving excellent service; if, in some instances, they are commencing to show slight signs of wear, they will still form most excellent foundations for asphalt tops. In this way they are proving a most economical investment for the city. Just this year the city purchased a Barber Asphalt Plant of 1,800 yards capacity which has turned out 25,000 yards of asphalt paving to date. Much of this is on old concrete base.

While taking up the subject of roadways it might be well to mention that the city of Windsor does its street cleaning by means of flushers of which there are two, one of 800 gallons capacity, and the other 1,250. Downtown districts are flushed every night while the rest of the city is cleaned twice a week. No sweeping is done at all.

The city of Windsor is very amply sewered and while it has enough area to house 65,000 people at a density of forty to the acre, still there are enough sewers to take care of fifteen to twenty thousand more people than at present resident in the city. Only one more mile of sewer is required to complete the drainage of the old portion of the city.

The city engineer has also jurisdiction over refuse disposal which is handled by the city's own incinerator. There were handled in 1921 over 9,300 loads of garbage, while in addition 7,325 loads of rubbish were disposed of in dumps.

Mr. Brian, in addition to his duties as city engineer, is also a member of the Essex Border Utilities Commission and a suburban area commissioner.

The Water Works

While the water works do not come under the direct jurisdiction of the city engineer, it may be well at this point to make some reference to them. They are the property of the corporation of the city of Windsor, and are controlled by a Board of Commissioners, consisting of the mayor for the time being and three commissioners elected by the people.

The original water works were constructed in July 1872. The pumping station was destroyed by fire in 1888 and was rebuilt immediately thereafter. The supply of water is obtained from the Detroit River through intake pipes and is supplied to users by direct pressure and without stand pipes.

The screen well, located at the edge of the river beside the pump house, is of concrete construction with brick superstructure, roofed over, measuring 25 feet 6 inches by 18 feet with semi-circular ends. The average depth of water is 13 feet which varies, however, with the height of water in the river. The design is divided in two by a double set of screens. The capacity at 13 feet is 42,500 imperial gallons.

The pumping equipment consists of four engines as follows:—two rotary electric single stage pumps with a capacity of six million gallons per day; one cross-compound high duty engine installed in 1903 having a capacity of five million gallons per day, and a cross-compound high duty engine installed in 1913 having a capacity of eight million gallons per day. There are three boilers of 140, 150 and 200 h.p. respectively. The total mileage of pipe at the end of 1921 was 72.35 miles and the number of headers was 672.

Ordinary pressure is sixty pounds while ninety to one hundred pounds is available for fire service.

Walkerville

In the town of Walkerville, there has been very little municipal engineering activity this season, but this has been due to the very good reason that the town is practically 100 per cent. paved and sewered. With the exception of two or three short stretches of road, which, in all likelihood, will be paved this year, every street and alley has a hard surface. The pavements which are now being most generally adopted are stone filled asphalt on concrete base. Some of this base is old concrete paving that has seen service for some years. All of the paving laid in the past few years has been concrete, replacing the old cedar block roads that were standard many years ago. Some of the concrete was sheet asphalted, but stone filled asphalt is now standard. This work is done by contract, Walkerville not having an asphalt plant of its own. A small amount of bitulithic has been put down.

The sewer system of Walkerville completely covers the town and is adequate for its present area and population. The sewers are on the combined system, carrying both storm water and sanitary sewage.

Buildings of the Border Cities

Minto's Store, Walkerville, Ont., designed by G. J. P. Jacques architect, Windsor and built by John V. Gray Construction Co.

Much Work in Ford

In Ford City there is promise of great municipal engineering development for several years to come, inasmuch as industries are expanding and the town is spreading to such an extent as to demand better sewage and road facilities. At present the town is possibly 15 per cent. paved and there are a number of roads under construction or in prospect to take care of the districts which are building up very rapidly.

As far as sewers are concerned, plans are prepared for the installation of a system to completely equip the portions of the town not now served by sewer facilities. The proposals call for separate sanitary and storm system.

Ford is also to be furnished with a complete system of water mains and sidewalks, which have been forced on the municipality by the rapid growth which is taking place throughout the entire town. The 1,100 acres recently added to the area of Ford required the installation of municipal facilities in order that their development may be along proper lines and it appears to be the intention of the authorities to see that these facilities are provided in the near future. This means that considerable activity may be expected so far as municipal engineering projects are concerned.

The engineering requirements of both Walkerville and Ford are under the direction and supervision of Mr. H. W. Patterson, who since July, 1920, has been town engineer, having learned the fundamentals of his profession by dint of hard work since early youth. He succeeded, as town engineer of Walkerville and Ford, the veteran Owen McKay, whose death not so very long ago was a distinct loss to the profession at large and especially to the engineering fraternity of Essex County and the Border municipalities.

Ojibway

The operations of the Canadian Steel Corporation, at Ojibway, have reached a stage where there are already constructed 7 stoves and two furnaces, ore unloading docks and a canal 2,600 ft. long and 200 ft. wide. It is assumed that these operations already involve an expenditure of $5,000,000. A considerable portion of this has been spent in laying out the townsite of Ojibway, which will, of course, not fully materialize until the steel plant has arrived at a more complete stage of development.

Just what the future prospects are it is not wise to forecast, inasmuch as the Canadian Steel Corporation are not prepared to make an authoritative statement. It is felt, however, by many who are in close touch with current events in the Border municipalities, that a very considerable progress will be made at Ojibway within a short while. It has been stated that the steel company plans vigorous activity along the lines on which it has already made a start.

Sandwich

In the town of Sandwich, the town engineer, Mr McColl, is busy at the present time preparing plans for the construction of roads and installation of sewers in many of the sub-divided areas. As yet, Sandwich has developed for the major part along the river front and for possibly an average of one-half mile back. Extensive areas more to the interior, however, have been sub-divided and considerable building activity has been noted. In anticipation of fast growing house development in the near future, the town is losing no time in making arrangements for the paving of the streets and the drainage of the area. Roads and sewers will, therefore, be constructed in the near future. As far as pavements are concerned, concrete is standard. For the sewer system, the town engineer has recommended separate sanitary and storm sewer pipes.

Mr McColl, the town engineer, has held this position for the past six years, having succeeded Mr Owen McKay, who served Sandwich for a long time previously.

Great Developments in Ford City

This Town Has Experienced a Remarkable Growth Which Has Been Sound and Permanent—Expansion Planned by Several Industries Will Mean Even More Rapid Development

Of all the Essex Border municipalities, Ford City has enjoyed the most rapid growth and development and from present indications, as intimated in announcements made by leading industries of the town, the prospects are that a future development will take place much greater in extent than any heretofore recorded. It was only ten years ago that Ford City was incorporated as a village with a population of only thirteen hundred; by a special Act of Parliament it was created a town in 1915 and has since speedily grown in population and extent. Just last year eleven hundred acres were annexed to the town giving it a total area of sixteen hundred and sixty seven acres. The population at the present time is over six thousand, two and half times that of 1916 which was twenty four hundred. The rateable assessment has kept pace with the increase in population and to-day is roughly three million, five hundred thousand dollars as against slightly over one million dollars six years ago. From these general statistics it is obvious that Ford City is perhaps the fastest growing city in Canada; at any rate it certainly surpasses all of the other Border communities.

U. G. Reaume, the Mayor of Ford City.

Large Developments in the Ford Motor Co.

The prospects for Ford City are almost beyond power of forecast. Enjoying a healthy development in the past this town should grow with ever increasing strides, which will be accentuated by the mammoth industrial expansion that is proposed by the Ford Motor Company of Canada, Limited, and other large commercial concerns located in the town. Within the last two or three weeks there has been specific indication of this trend in an announcement made by The Ford Motor Company concerning its proposed activities. These are explained in a memorandum which has been submitted to the "Contract Record" by W. R. Campbell, vice-president and treasurer of the company, which states that the company has now completed purchase of property which will enable it to carry out certain definite plans for future expansion. This property, comprising approximately two thousand feet of frontage on the river, extends from the westerly limit of the present main plant to Belle Isle Avenue. An industrial tract has also been acquired to the extent of approximately 125 acres, all of which is adjacent to the fifty-acre tract acquired by the company between the Grand Trunk and the Essex Terminal Railways some years ago, so that the property now acquired consolidates all Ford properties. Approximately $1,000,000 has been spent in acquisition of the new properties.

In making the announcement Mr. Campbell stated that plans for expansion were due to the faith which the company has in the future of Canada and the other British Colonies served by the Ford Motor Company of Canada, Limited. The future development of the deep waterways project and the trade within the Empire by means of ocean going craft sailing direct from Ford is seen by reason of the fact that it is the intention of the company to devote all new river front property largely to dockage and shipping facilities.

The immediate plans of the company call for the erection of a large factory building on the site previously owned, between the Grand Trunk and Essex Terminal Railways, and as conditions warrant additional buildings will be erected to take care of the company's growing trade. It is also probable that in the very near future a power plant will be erected on the property recently acquired between the Grand Trunk and Sandwich Street west of the Ford City public school.

Plant to be Doubled

The future plans of the company contemplate the erection of additional machine shops, forge shops, foundry, body shops and in fact facilities for the manufacture of fabrication of practically all material entering into the completed product of the company. It is the intention, as early as possible, to double the capacity of the plant from a maximum output at the present time of 250 cars per day to 500 cars per day. With the property now acquired, further expansion may be taken care of as conditions warrant. Sufficient property has now been acquired to allow an output of 1,000 cars per day when the trade demands it.

A staff of engineers is now engaged on property and plant layout. The plans contemplate the erection of one story buildings, daylight roof lighting and the development of the new property will mean the gradual abandonment of the present plant as the main manufacturing centre of the company. In all probability the present buildings on the river front will, as the evolution takes place, eventually be devoted to the manufacture of bodies. The very latest equipment will be installed in order to reduce manufacturing costs to a minimum so that Ford products may be sold at the very lowest possible figure.

The Ford Company's announcement marks a period of resumed expansion on the part of the company. It was pointed out that the company has not done any building for several years past and after having gone through the period of depression following the armistice a new era of prosperity is seen in the future.

The Ford Company has enjoyed a healthy business for the present year and with its export business returning, additional facilities are required and it is confidently believed that the Canadian market also is capable of the absorption of a much larger output. Conditions throughout Canada generally are healthy and the company believes it is justified in establishing plant facilities capable of meeting the demand for its product.

Other Concerns Planning Expansion

There are other concerns in Ford that are planning expansion, perhaps not quite as extensive, but at any rate to an extent that will lead to great development in the town itself. It is quite safe to assume that as a result of the immediate doubling of the Ford plant's capacity and prospective quadrupling of its facilities, there will be a big increase in the population. Many persons who are enthusiastic over the new developments feel that 50,000 is not too low a figure for the ultimate population of Ford City; at any rate the number of persons employed in the plant of the Ford Motor Company will be increased from the present 3,000 to 10,000.

It must not be assumed that the Ford Motor Company's plant is the only one in Ford City. In many minds the name of "Ford City" tends to give this impression; however, there are a large number of other industries which have helped to build up Ford City, guaranteeing its future prosperity and development. Such industries as the Fisher Body Corporation, Dominion Forge & Stamping Company, Canadian Lamp & Stamping Company and Imperial Oil Limited, are well established in the town and are giving employment to hundreds of workmen, and are enjoying healthy trade with promising prospects. A few others that might be mentioned are Wilson Brothers, Ontario Asphalt Block Company, E. C. Poissen Lumber Company, C. A. Chilvers Company, Ford City Bottling Works and W. T. Westgate Ice Cream Company. In addition there are such contracting firms as the Chick Contracting Company, Merlo, Merlo & Ray and Cadwell Sand and Gravel Company, which are contributing their share towards the industrial development of Ford. These industries give employment to 5,000 persons—more than the employable population of the town itself—which means that there is every day a large influx of workers to the town. It may be noted, however, that Ford City industries have a far greater than a mere local influence, for many companies in other parts of the province contribute parts or materials to many of the Ford City companies. In this way Ford City is having considerable effect on the industrial growth of towns outside itself.

Splendid Inducements

Ford is obviously a town that offers splendid inducements for industrial concerns, otherwise so many would not have established there. With a splendid water front, excellent railway service and close proximity to Detroit, there is every reason why industries should locate there. At the same time Ford offers inducements along residential lines and to-day there are dozens of houses being built on some of the fine sub-divisions of Ford.

It is understood that there are several builders preparing to extend their activities in that municipality, building possibly 100 or 150 houses. The authorities are making every effort to encourage people to settle there and plan big local improvements to take care of numbers of residents. The 1,100 acres which were annexed last year require some attention in this connection. The point is, however, that there is no need to fear any inactivity in Ford, for with the inducements that are offered by virtue of the town's location and industrial importance, the population is bound to grow and prosper rapidly; in fact, since the beginning of the year there have been 122 permits issued, aggregating in value $426,000.

All this of course means that there must be an increase in the number of stores, shops and offices, improvement in the postal facilities and expansion in the police and fire departments; all this will naturally follow any great expansion in the town.

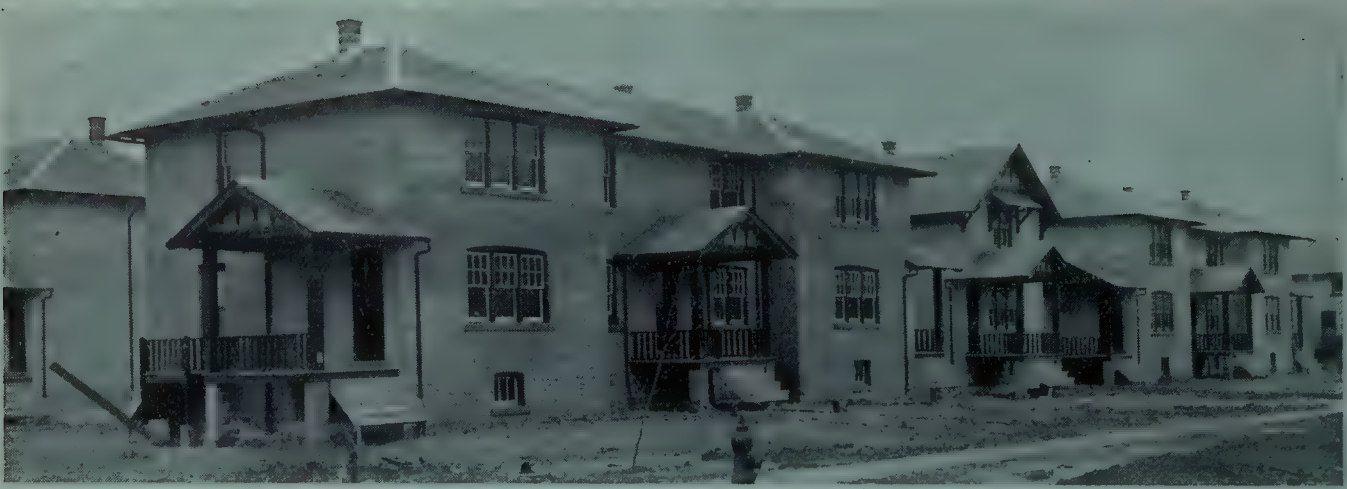
Knights of Columbus Hall in Windsor

A Knights of Columbus club house in Windsor is being erected at a cost of approximately $75,000. The architects, Messrs. Pennington & Boyde of Windsor have planned the building primarily as a recreation club house and have included a swimming pool, bowling alleys, banquet hall and auditroium. Perhaps the principle feature of the building is the auditorium which will be the largest auditorium in the Border Cities.

The basement is enclosed by heavy concrete walls which support structural steel frame work including heavy steel girders which span the entire width of the building, thus providing the floor space above the ground floor entirely free from supporting columns.

The new building will adjoin and be connected to the present building and when completed will make one of the finest and most carefully equipped club house of its kind, in Canada. The general contractor is the Walker-Linden Co., Windsor.

Ford, Ont., offers special residential inducements. These pictures show typical homes in the district



Houses erected by the Windsor Housing Commission

The Work of the Housing Commission

The Border Cities Have Been Very Active in the Matter of Building Houses—Substantial Types of Homes

The efforts of the Housing Commission at Windsor have been attended by, perhaps, a greater measure of success than at any other point in Canada where the government scheme of financing has been adopted. In fact the scheme has been 100 per cent. successful, every single residence of the original program of 50 being occupied at the present time and accounts are reported in excellent condition. The houses are substantial structures, attractively finished with cement stucco exteriors, and are located on Bruce St. and Tecumseh Rd., in the southwest section of the city. They are erected in series of triples, doubles and singles and the exterior construction details have been varied, getting away from that appearance of sameness that seems to be a part and parcel of most housing schemes. They were sold to purchasers at actual cost.

The commission is still in existence although no further government grants are available at present, at least, for house building purposes here, any development in the immediate future depending on civic grants. It may be safely stated that Windsor has spent more money on housing development and secured better results for the money spent than any single municipality throughout Canada.

The houses as illustrated herewith were designed by Mr. Gilbert J. P. Jacques, architect of Windsor, and the R. Westcott Co. Ltd., local contractors, were in charge of the construction.

Walkerville Housing

Walkerville's progress along the lines of housing development, too, has been progressive. A company known as the Border Housing Company was formed in 1920 to build homes for the accommodation of the employees of the town's large industries. Several of the houses constructed, which are of similar interior design, are illustrated and fully described in our April 27th issue last year. As in the case of the Windsor homes, monotony of design has been eliminated without sacrificing economical standardization. The program here comprised the erection of approximately 100 homes, the financing of which was taken care of by a government housing appropriation and private funds of the above mentioned company.

From these few brief facts it will be seen that the housing end of the Border cities progressive development is keeping pace with the industrial movement forward and the rapidly increasing working population is being provided with comfortable, attractive and substantial homes, available for purchase at terms within the means of the ordinary working man.

Buildings of the Border Cities.

The warehouse of J. T. Wing & Co., designed by J. C. Pennington and built by the John V. Gray Construction Co.

**JOHN V. GRAY
CONSTRUCTION CO.**
LIMITED

General Building Contractors

Bartlet Bldg., 28 London St. West, WINDSOR, Ont.

The following is a list of buildings we have constructed, or have in course of construction, in the Border Cities:

Addition to Warehouse of J. T. Wing & Co. Ltd., Windsor.
St. Francis School, Sandwich.
Bartlet Office Building, Windsor.
Walkerville Land and Building Co.'s main office.
St. Clare School, Windsor.
Eaton Clarke Co.'s warehouse.
Imperial Bank, Walkerville.
Minto's Store, Walkerville.
Coal handling plant for Wm. Woollatt & Sons, Walkerville.
Champion Spark Plug Co.'s factory.
Addition to St. Joseph's School.
Club House for Municipality at Wigle Park.
Comfort Station of reinforced concrete, Windsor.
Bank of Montreal, Leamington.
Swift Canadian Co.'s warehouse, Windsor.

With our large organization, competent staff and wide experience, we are able to handle any building project. When you are considering construction work of any kind, we should be glad to have the opportunity of discussing plans with you and tendering estimates.

GILBERT J. P. JACQUES

Registered Architect

Member O.A.A., R.A.I.C. AND A.M.E.I.C.

Suite 204, 3 Ouellette Ave., Windsor, Ont., Phone 5032

Some recent designs:

Windsor's New Police Building,
St. Francis School, Sandwich
Houses for Windsor Housing Com.,
Davis Store and Apt. Bldg.
St. Clare School, Windsor
Minto's Store, Windsor
Riverside School, Riverside, Ont.
Keyser Apartment Bldg., 37 Apts.

and others too numerous to mention.

Builders Supplies

We carry a complete selection of everything required by the building contractor

FIVE BIG YARDS IN THE BORDER CITIES

ESTABLISHED OVER 20 YEARS

We Own and Operate Gravel and Sand Barges

Cadwell Service is Unexcelled

CADWELL SAND & GRAVEL CO.

LIMITED

228 Sandwich Street West **WINDSOR** **Phone 2800**

SPECIALISTS IN ROAD BUILDING GRADING, EXCAVATING, AND PAVING

A few of our recent contracts

- Dept. of Public Highways.
- Kingston Highways. Dunbarton.
- Kent County.
- Essex County.
- Belle River, Ont.
- Ford, Ont.
- Walkerville, Ont.
- Windsor, Ont.
- Sandwich, Ont.
- Kingsville, Ont.
- Leamington, Ont.
- Riverside Drive.
- Sandwich East Twp.

Merlo, Merlo, & Ray, Limited
Walkerville, Ontario

L. A. Merlo	*President*
J. H. Ray	*1st Vice-Pres.*
P. Merlo	*2nd Vice-Pres.*
C. A. Chilver	*Treas.*
F. W. Barclay	*Sec.*

CAMERON & RALSTON
ARCHITECTS
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WINDSOR, - ONT.

Lumber and Mill Work

Equipped to Handle

INDUSTRIAL WORK

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Car Lots or Yard Delivery

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W. Greisinger,
Secy. & Treas.

Windsor, Ont.

Cameron Ave.

Phone 2900

Prince Edward Hotel, Windsor, Ont.

BUILDERS' SUPPLIES

On the following buildings

Prince Edward Hotel, Masonic Temple, Victoria Ave. School, Prince Edward School, Walkerville Continuation School, Windsor-Walkerville Technical School, Devonshire Race Track, General Motors Building, Hydro Electric Station.

By the

Chick Contracting Co. Limited

951 McDougall St. : Windsor, Ontario

Hundreds of Industries

Unequalled shipping facilities, either lake or rail, proximity to raw materials' supply, easily reached markets, generous policy of associated municipalities,

WINDSOR

The logical location in Canada for the establishment of branch industries. Easily reached from the large manufacturing cities in Michigan, Ohio, Illinois and Indiana.

The centre and largest of the Border Cities, one of the most progressively managed municipalities in the Dominion. Population now over 40,000 and growing at a rapid rate. Educational facilities unsurpassed two schools having been erected and opened during the last year at a cost of over $1,000,000.

Live manufacturers everywhere are invited to come and join this community of aggressive, wide-awake business men. They will find here 'the proper atmosphere in which to develop with the inevitable growth of their market in Canada.

Export business with Great Britain, her colonies and other countries can, it has been found, be handled more satisfactorily from the Windsor branch of an American industry.

Windsor appreciates industry and has adopted a liberal policy to encourage its development within her borders.

H. Wilson, Mayor — Martha Dickinson, City Clerk.

WALKERVILLE

Walkerville is situated on the Detroit River directly opposite the City of Detroit. The Town has excellent transportation facilities both by rail and water and, as one of the border cities, it is the chief manufacturing and industrial centre of Western Ontario. The educational institutions and and churches are unsurpassed. The surrounding country is a rich agricultural and fruit-growing area and has large areas available for industrial sites in close proximity to railways.

Assessed Value for Taxation		$11,385,346
Exemptions not included above		939,038
Total Funded Debt, (including present issue)		2,165,728
LESS: Electric Light Debentures	$225,489	
Schools	800,482	
Housing Debentures and Ratepayers' Share Local Improvement Debentures	669,219	1,695,190
Net Debenture Debt		470,538

Population - 7,303 Area - 1,000 Acres.

The Municipality owns its own electric light plant and for the last fiscal year operations showed a net profit for the Municipality of $16,302 after allowing for operating expenses, depreciation and all fixed charges.

Charles J. Stodgett, Mayor. — A. E. Cock, City Clerk.

Border Cities -- Canada's

Select Border Cities

ample labor supply, all combine to place the Border Cities in pre-eminent position as Canada's Premier Manufacturing centre.

FORD

Fastest growing city in Canada.

The Canadian home of the world's greatest motor car builder.

The conditions which have led to the selection of this city by so many leading manufacturers should make Ford the logical choice of other live manufacturers.

Present population, over 6,000 an increase of 250 per cent in five years.

Area of city 1657 acres giving plenty of available locations for new industries which will enjoy the advantages of shipping facilities on all railways as well as by cheap water routes, the use of public utilities and association with a city filled with the spirit of enterprise and co-operation.

As a residential city Ford possesses outstanding advantages.

A broad-minded policy on the part of the Mayor and Council has been adopted and every encouragement is being offered to the manufacturer looking for a suitable location for his factory, or the home builder anxious to cast in his lot with a city full of enterprising, industrious people.

U. G. Reaume,
Mayor.

J. F. Foster,
City Clerk.

SANDWICH

The ideal residential area for the Border Cities.

Not overlooking the obvious advantages which this city offers as the site for the establishment of industrial enterprises. Sandwich is laying broad-guage plans to provide for the thousands of prosperous future citizens of the Border Cities, opportunities for acquiring homes under most favorable conditions.

The location of Sandwich makes it particularly attractive from this stand-point and natural advantages are being capitalized to a satisfying degree.

The extensive construction of roads, the installation of sewers and general plans for taking care of the health and comfort of her people are proof of the appreciation on the part of the Sandwich municipal officials of their opportunities and responsibilities.

Development in the Border Cities generally will be reflected in greatly increased activity in Sandwich and will find this community well prepared to fulfil its special function, that of providing sites for homes under well nigh perfect conditions.

E. Bereault,
Mayor.

E. R. North,
City Clerk.

Greatest Industrial Centre

Some Jobs Executed by Us:

Ford Motor, Ford, Ont.

Universal Car Agency, Windsor

Walkerside Dairy Bldg., Walkerville

Bank of Commerce Walkerville and Ford

Ideal Fence and Spring Co., Windsor

Motor Products, Walkerville

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C. M. BENNETT
Painter and Decorator
17 Wyandotte St. - Walkerville

Largest Stock West of Toronto

Some Jobs Executed by Us:

General Motors, Walkerville

Walker & Sons' New Offices, Walkerville

Dominion Forge and Stamping Co., Walkerville

Home Bank, Walkerville, Sandwich and Tecumseh

And Others

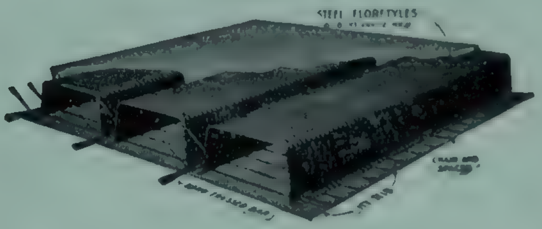
"EANSOR SERVICE"

has been identified with the great majority of large contracts and numerous small jobs in the Border Cities.

Structural Steel
Ornamental Iron
Building Specialties

T. J. EANSOR & SONS
300-310 Pitt St. East WINDSOR, ONT.

PRINCE EDWARD SCHOOL, WINDSOR, ONT.



In the above beautiful example of an up-to-date FIREPROOF school reinforced concrete with Truscon Steel Floretyle and Trussed Bars were AGAIN used.

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The above school was designed by A. H. McPhail, Architect, and built by the S. E. Dinsmore Company, Contractors, both of the Border Cities.

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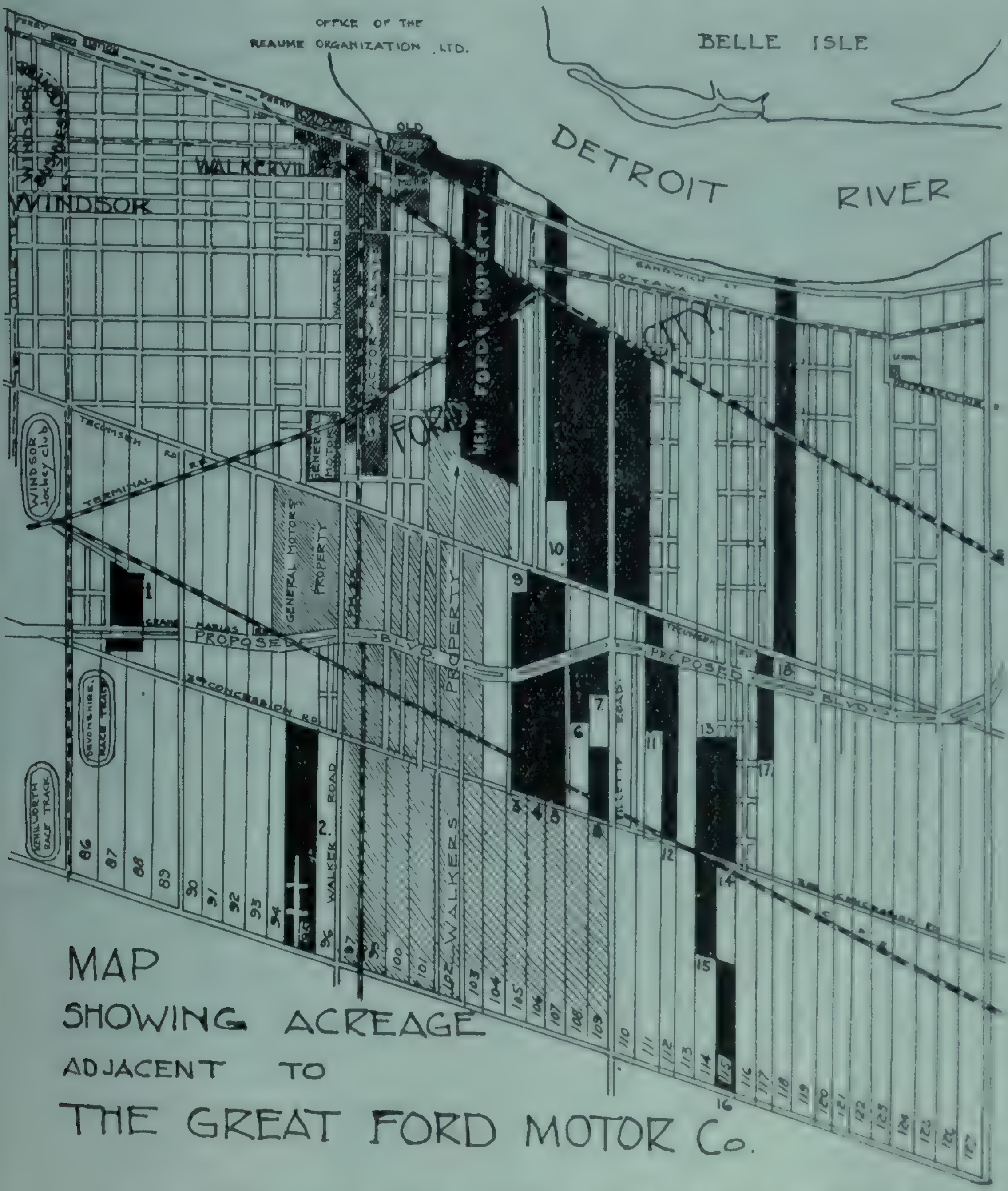

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Essex Provision Co.,	Windsor, Ont.
Bell Ice Co., additions,	Windsor, Ont.
Essex High School,	Essex, Ont.
Imperial Block,	Walkerville, Ont.
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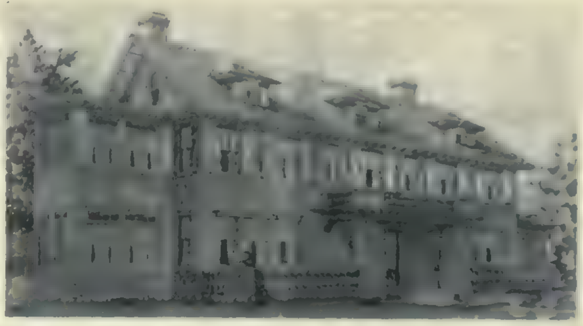
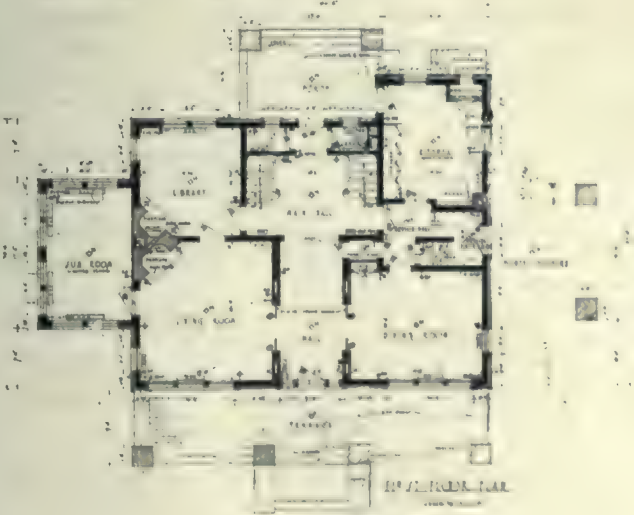
Weekly House Suggestion No. 28

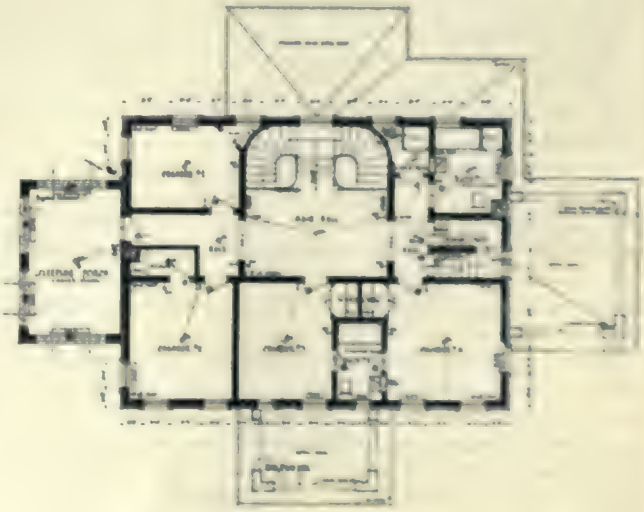
The handsome residence we are showing this week which was designed by Mr. Gilbert J. P. Jacques, 8 Ouellette Avenue, Windsor, Ontario, and erected in that city for Mr. Banwell, embodies a number of elaborate features in keeping with a residence of this type. The main construction is red pressed brick with stone trim. There is a full width terrace across the front of the house with wooden railing and floored with red quarry tile. There is also a roomy porch at the rear with metal roof and a porte cochere on the right, as seen on the plan reproduced herewith, also with suspended metal deck. The flooring throughout the house is of oak and the trim is in mahogany and white enamel. The living room and library are equipped with brick fireplaces constructed in adjacent corners of these rooms as seen on plan. The dining room is equipped with a built-in china closet and is conveniently situated with entrance from the service and front halls. There is a beautiful southern colonial type staircase situated in the main hall, which is finished in mahogany and white enamel in keeping with the balance of the trim. The kitchen is conveniently situated to the dining room, being separated from it only by the service hall; it is equipped with the latest up-to-date service features including built-in refrigerator, which is iced from the outside, roomy cupboards, etc. This room has a separate entrance from the rear porch. There are also a large sunroom, lavatory and phone booth on this floor.

The second floor plan comprises four bed chambers, sleeping porch over the sunroom and two bathrooms; all conveniently situated off the main hall. There is ample closet and wardrobe space in connection with all bed chambers and the scheme of decoration is the same as on the first floor. There is a clothes chute on the second floor to the right of the main staircase to the laundry in the basement. The heating system of the house is of the hot water type.



In this short article we have called attention to but a few of the interesting points, of this excellently designed, better-class home, which may be seen in the accompanying plans and photo.





Power Plant for Thessalon, Ont

Contracts have just been awarded for the construction of a small power plant at Thessalon, to be known as the Thessalon Power Development. The complete work calls for a concrete dam, 390′ of 48″ wood stave pipe line, and a concrete power house. The plant will operate under a head of 40 feet. The capacity of the plant will be in the neighborhood of 200 h.p. The dam is being constructed by Messrs. MacNamara at a cost of $15,300. The turbine, generator and direct-connected exciter will be installed by William Kennedy and Sons, Owen Sound, Ont., at a cost of $9,200. James, Proctor and Redfern Ltd., are the consulting engineers.

Mainly Constructional

East and West—From Coast to Coast

The reclamation branch of the Provincial Public Works Department is making a survey of the damage done by the recent flood in Manitoba. Brandon and district were the hardest hit, considerable damage resulting here to crops and personal property.

The council of York Township, Ont., a few days ago authorized debentures for $60,000 for the completion of a 24-roomed school and the sum of $280,493.77, the aggregate of several local improvement by-laws, was also passed.

Roughly estimated, $10,000,000 is the amount that will be spent in Canada this year on good roads development under the Federal Highways Act, irrespective of road work of a local character. Ontario's expenditure will approximate $4,000,000 and Quebec's $2,000,000. Work this year on roads, it has been stated, is being carried out at about 30 per cent reduction compared with last year.

London, Ont., it is announced, has been advised by the Ontario Board of Health that the present sewage disposal plant must be replaced, this present plant, according to authorities of the department, constituting a public menace to the health of the community. The estimated cost of a plant to serve this district is $400,000.

A start was made recently on the work of development at the port of Quebec. The sum of $1 500,000 was authorized by the government recently for this development and no time was lost in getting work actually under way, dredging being commenced on the St. Charles River.

An active season in the lumber camps is anticipated this year, the busy building season having left stocks in a depleted condition. The re-opening of several lumber companies is looked for.

The Works Department, at Toronto, has issued an order to John E. Russell, Limited, for the construction of the new bridge on Gerrard Street over the Don. The contract was signed some days ago and the work is to be finished inside of 16 months. There is a penalty of $300 per day over that time and a bonus of $50 per day if the bridge is completed before the date set.

Messrs. James, Proctor & Redfern, the well known Toronto firm of engineers, have been asked by the city of Hamilton to submit plans for a new sewage system and disposal plant. The sum of $2,500,000 is involved in this proposed development. Mr. Charles Avery of Toronto was also appointed assistant to the consulting engineer.

The Fegles Construction Company, of Fort William, Ont., have been granted a permit to erect an elevator at the plant of the N. M. Paterson Company, in West Fort William. This structure will cost $180,000.

Excavation for the Pathological building, the first of the three McGill buildings which are to be erected during the summer and fall, has been completed. This building will be erected on University Street above Pine Avenue, in that part of the McGill grounds known as Macdonald Park. Excavation for the other two buildings will be started probably within a few weeks. These buildings are the gymnasium and residence building, which will be constructed on Sherbrooke Street, opposite the McGill Union, and the Mining and Geological building, which will be situated on the southwest corner of Milton and University Streets.

Personal

Mr. D. W. Johnston, recently resigned from the position of city engineer of South Vancouver, B. C. He will probably join a paving and contracting company in Vancouver.

Mr. A. P. Harrop, town engineer of New Glasgow, N. S., has left to reside in Chatham, Ont., where he has obtained an appointment with the Canadian Des Moines Steel Co.

Mr. C. Price-Green, Commissioner, Industrial and Resources Department, Canadian National Railways, Toronto, has been elected a Fellow of the Royal Geographical Society, according to a recent report from London, Eng.

Messrs. Johns & Woods, it is announced, will shortly open a crushed stone business in Hamilton, with plant at the corner of Hilliard and Brant Streets, on the G.T.R. right-of-way, on the Beach line. The stone will be imported from the North country, according to our information, and will be used particularly for stucco and granolithic floors.

Obituary

Mr. Charles Falconer Miles, prominent surveyor of Toronto, died recently in that city. Deceased came to Canada from the Old Country in 1857 and studied land surveying, becoming a qualified O.L.S. in 1862 and later a Dominion Land Surveyor. He had charge of considerable work in the early days for the Federal government at Keewatin, Manitoba and the north-west territories. In recognition of his splendid work in these districts, he was appointed inspector of surveys for Western Canada, which position he occupied until he retired in his 82nd year.

Trade Incorporations

The Sydenham Brick and Tile Co. Ltd., with head office at Wallaceburg, Ont., capital $40,000, to manufacture and deal in brick, tile and other products.

Spruce Falls Housing Corporation, Ltd., with head office at Kapuskasing, Ont., capital $40,000, to carry on a home building and real estate business.

The Canadian By-Products Company, Limited, with head office at Hamilton, capital $600,000, to manufacture fire brick, building brick, building tile.

Chisholm Construction Company, Ltd., with head office at Lancaster, Ont., capital $45,000, to carry on the business of general railway contractors.

De Paoli Company, Incorporated, capital $5,000, to manufacture and deal in tiles, slates, terrazzo, etc.

Sterling Construction Company, Ltd., with head office at Montreal, capital $49,000, to carry on a general contracting and engineering business.

Approximately $1,500,000 will be expended on roads in the province of British Columbia this year. One of the most important projects in the programme for this year is the construction of concrete pavement through and on either side of Langley Prairie, contract for which is held by Messrs. A. B. Palmer & Co.

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

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THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
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SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U.S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, August 2, 1922 No. 31

The Industrial and Financial Outlook

"Conditions at the close of the first half of 1922 indicate that business will expand moderately during the autumn and winter months. It is now one year since the definite beginning of recovery from the depression of 1920-21. Progress was slow until the close of 1921, but since the beginning of 1922 improvement has been rapid. Money is cheap. The crop outlook is excellent. With few exceptions, stocks of raw materials and of manufactured products are not larger than necessary to bridge the normal period between production and consumption. Commodity prices are rising. The movement at present seems to be primarily one of adjustment between the different classes of commodities, and as long as the upward tendency does not assume a speculative character, it is a favorable factor. Except for strikes, there is little idleness. Production has expanded steadily since the beginning of the year, and as yet the usual mid-summer dullness has been little felt."

This latest summary, by the National Bank of Commerce, makes special reference to conditions in the United States. but these should not materially differ from our own. In many ways Canadian conditions are better. An example is the apparently saner attitude of Canadian "Labor" which has not allowed itself to be led into such disastrous strikes. Comparatively speaking, too, our wonderful crop prospects mean more to us, as our western provinces, where the bulk of the grain is grown, has been the weakest link in our credit situation. A good crop will work wonders in all directions and put "heart" into our rural population, where there has been little enough encouragment during the last two or three years.

As another indication of improving conditions, it is worth noting the course of the security market during the present summer. Bonds and stocks, in general, experienced a substantial revival during the first six months of the year and financial men looked for a quiet time during the holiday season, with the probable accompaniment of receding prices. As it has turned out, to-date, there has been little let-up in the amount of business transacted, and little if any, price recession. In a number of directions there have been quite marked advances. This indicates not only that the investor is regaining confidence, but also that he continues to have the money to spend.

There is another phase in the investment situation that is developing in the regular way. The very early stages of a trade revival are invariably preceded, financial statisticians tell us, by a demand for and a consequent increase in the price of high class bonds. At later stages when bonds become less attractive by comparison with industrial securities there is a gradual movement from municipal and government bonds to those industrials. This not only applies to the general investing public but also to the banks and other financial institutions, who in quieter times were quite willing to forego the larger financial returns in order to gain greater security but who, with the returning confidence, gradually diminish their high class investments for more remunerative securities or so that they may be in a position to accommodate their commercial customers. At the present moment we appear to be well advanced in this second investment stage, indicating that we are following the natural cycle of former periods. With the increased confidence in industrials and larger sums of money available for development comes, of course, a quickened industrial activity.

Nobody looks for and nobody wants a boom, either industrial or otherwise. What we all want and need, and also what we seem to have excellent prospects of getting, is a steadily improving condition, both as regards confidence, public demand for commodities, public ability to purchase commodities, and manufacturers' ability to supply them. There is no apparent reason to readjust the forecast we have already ventured in previous issues, that we are steadily moving to normal trade conditions, and will probably reach a point of stability in the early part of 1923

Ten Per Cent. Closest Profit

In the past when work has been scarce and bidders plenty, we have bid actual cost in order to keep our organization together. Experience has shown that this does not pay. It would have been money in the pocket to keep our best men on the payroll and doing nothing rather than to have taken a lot of work at cost, which usually prevented us from being in position to get good work at fair figures when same was available. We believe that a contractor engaged in "public works" (which is our line of work) should not bid closer than 10 per cent. in times of depression. Wet weather and other unforseen contingencies often times will wipe out this slight margin.—H. B. Sproul in "Constructor."

Development of the Port of Vancouver

Number of Schemes Which Aim to Co-ordinate the Waterfront Facilities of Canada's Principal Western Seaport—Status of Second Narrows Bridge Project—Pier and Dry-Dock Construction

By J. B. HOLDCROFT, A.M.E.I.C.
Contract Record Correspondent

With the rapidly increasing volume of business handled through Vancouver as Canada's principal western seaport, great interest is being manifested in a number of schemes which have as their object the linking up of the various streches of waterfront and the railroad terminals so as to secure both proper co-ordination and the room for expansion which is such a prime necessity to an industrial and shipping centre of growing importance. The population figures alone afford an excellent indication of the extent to which growth is taking place, the figure for the current year, as compiled by the city directory, being given as 237,000 as compared with only a few thousand in excess of 100,000 at one time during the war.

Among the projected works, the first in order of interest at the moment is undoubtedly the Second Narrows Bridge, which will give direct rail and highway connection between Vancouver and the city of North Vancouver on the north shore of the inlet. Since mention was made of this project in a recent issue (July 12, page 689) the engineering and financial details have become available, and by-laws authorizing the floating of the necessary bond issues are being submitted by the municipalities interested in the scheme.

A Million and a Quarter for the Bridge

The price tendered by the McClintock Marshall Company of Pittsburgh for the bridge complete is $1,241,530 and was based upon the acceptance by the municipalities concerned of the method of financing proposed by the promoting bridge company. The basis on which the company was prepared to proceed is approximately as follows: (1) The City of Vancouver to be called upon to pay towards the cost the outstanding balance of $200,000 which was raised for this purpose under by-law in 1911 and subsequently diverted to other purposes when construction was necessarily delayed.

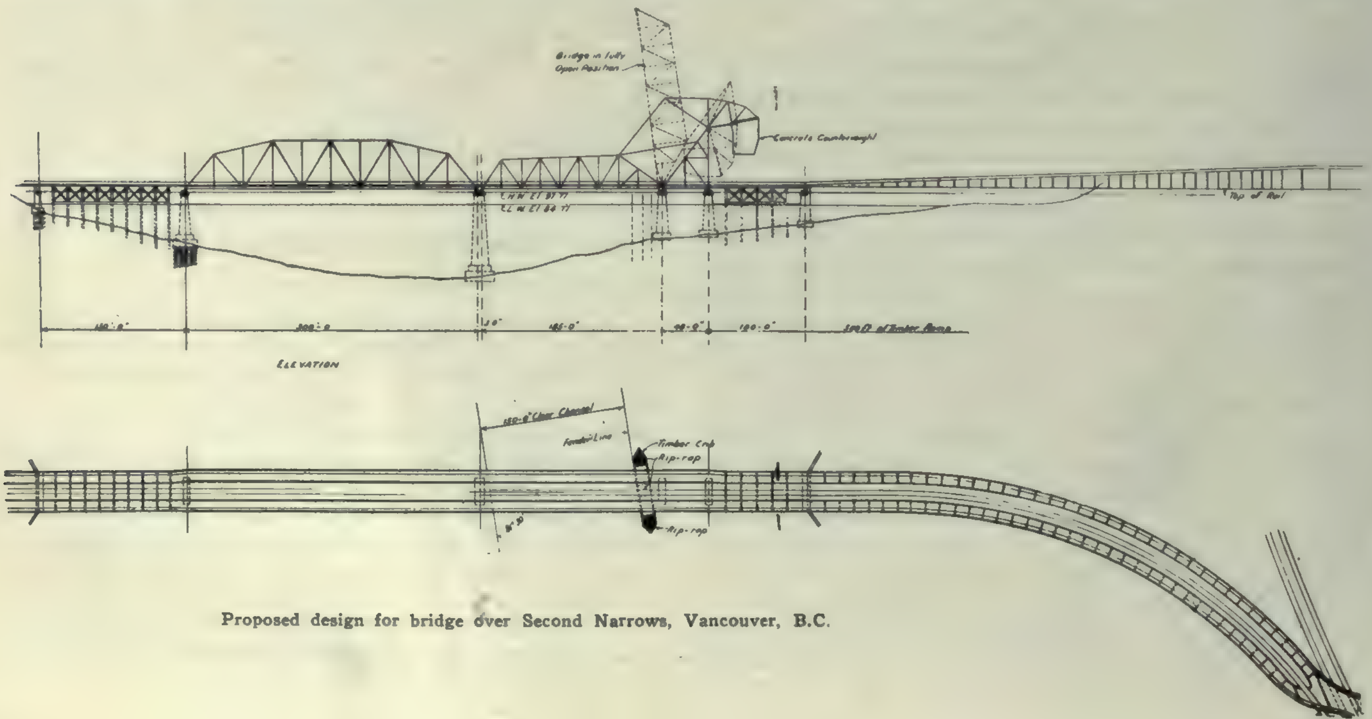
(2) North Vancouver city and North Vancouver district councils to pass by-law for authorization of another sum of $250,000 as the contribution of the north shore interests.

(3) The bridge company, by which is meant in this case the Burrard Inlet Tunnel and Bridge Company, the original promoting company, whose stock is held by the cities and municipalities interested in the project, to issue bonds to the amount of $500,000, the two north shore municipalities to guarantee the issue.

(4) The syndicate represented by the McClintock-Marshall Company on their part agree to take all the bonds to be issued under the proposal at par and dispose of them on their own account. The issues are to bear 6% interest.

During the course of the negotiations it developed that the surveys so far made of the subsurface conditions at the Second Narrows are not reliable, so that the foundation work is to that extent problematical. To cover this risk an addition was made to the tender which brought the total up to the amount stated, and the increase has been apportioned among the parties to the agreement.

The bridge will connect on the Vancouver side of the Inlet with the north end of Kootenay Street, one



Proposed design for bridge over Second Narrows, Vancouver, B.C.

block from the city limits. There will be a four per cent. grade from the street along the approach to the level of the bridge proper, and the approach will span the C.P.R. main line, which parallels the south shore of the Inlet, with a clearance of 22 feet.

The bridge itself will have an elevation of approximately 20 feet above high water, thus allowing sufficient clearance for the passage of mosquito craft at all stages of the tide. A bascule opening 150 feet in the clear will also be provided. It is the uncertainty regarding foundation conditions for the bascule piers that has resulted in an increase in the tendered price of about $200,000 above the figure first mentioned.

The north shore is touched just to the east of Lynn Creek, and a steel bridge crossing this creek is included in the scheme and tender, which also includes a mile of railway track on the north shore, which will take the track up to the eastern limit of North Vancouver city.

Pier Construction

Actually under construction the principal project is the Dominion Government Ballantyne pier, the interesting features of which were described in a recent issue of the "Contract Record." (Apr. 5, page 298) Preliminary work has also been done on pier BC of the Canadian Pacific series of piers, while tenders for the superstructure are now being called for. The pier, like the Ballantyne pier, is of the central gravel fill type, with the sides of the fill sloped away at or below the natural angle of repose of the material. The superstructure will be, it is understood, on creosoted piles, uniformly with the construction adopted for the present piers, "A" and "D".

The harbour or terminal railway is another scheme on which an early start is anticipated, this being a project of the Vancouver Board of Harbour Commissioners, to cost something over $80,000. This railway is planned for the purpose of providing connection between the Canadian National terminals on False Creek and the new Ballantyne pier. Construction was to have commenced almost immediately, but has been temporarily delayed, it is understood, in view of the pending changes in the personnel of the Harbour Commission.

Another development which is regarded as likely to materialize in the near future is the provision of additional grain elevator capacity. The grain handling trade of the port is growing at a rapid rate, and there are well founded rumors that the Dominion Government is planning the erection of a large capacity elevator on its False Creek property, the Indian Reserve at the English Bay end of the Creek. Work on this site was started some two years ago, and was then shut down, but the provision of grain handling facilities at this point would be an entirely logical addition to the Canadian National terminals which are located at the head of False Creek and would be connected with the proposed dock extension of the harbour railway scheme.

Local interests are also keenly alive to the need of a dry-dock for handling ship repair work and a movement is on foot to provide this addition to the port's facilities. The Wallace-Coughlan interests, as representing the principal ship-building interests of the port, have been working on this for many months and the Chamber of Commerce is now taking an active part in the project with a view to financing the construction locally, if possible.

Vancouver has an enormous waterfront tributary to it, and the construction of the works mentioned will furnish a ground work of future development in providing more efficient links for intercommunication. This, of course, applies particularly to the Second Narrows Bridge and the Harbour terminal railway schemes. These two works will have the effect of linking the two shores of Burrard Inlet, thus practically doubling the accessible waterfrontage of the main harbour, and of providing rapid transit for the industrial area of which False Creek is the centre. Further expansion, if such ever becomes necessary, can be provided for on the north channel of the Fraser River, about six miles to the south, with its fourteen miles of navigable channel before New Westminster is reached.

Hamilton, Ont., is to Study Sewer System and Sewage Disposal

During the last six months the Hamilton City Council have been considering the question of calling in a consulting engineer to act in conjunction with city engineer Gray in going into the whole matter of sewage disposal and the main trunk sewers. It is estimated that between two and three million dollars will have to be spent during the next three years on the construction of sewage disposal works and main trunk sewers. The construction of the sewage disposal works has become necessary due to the growth of the city and with the object of keeping the waters of Hamilton Bay in good condition as additional protection to the water supply of the city.

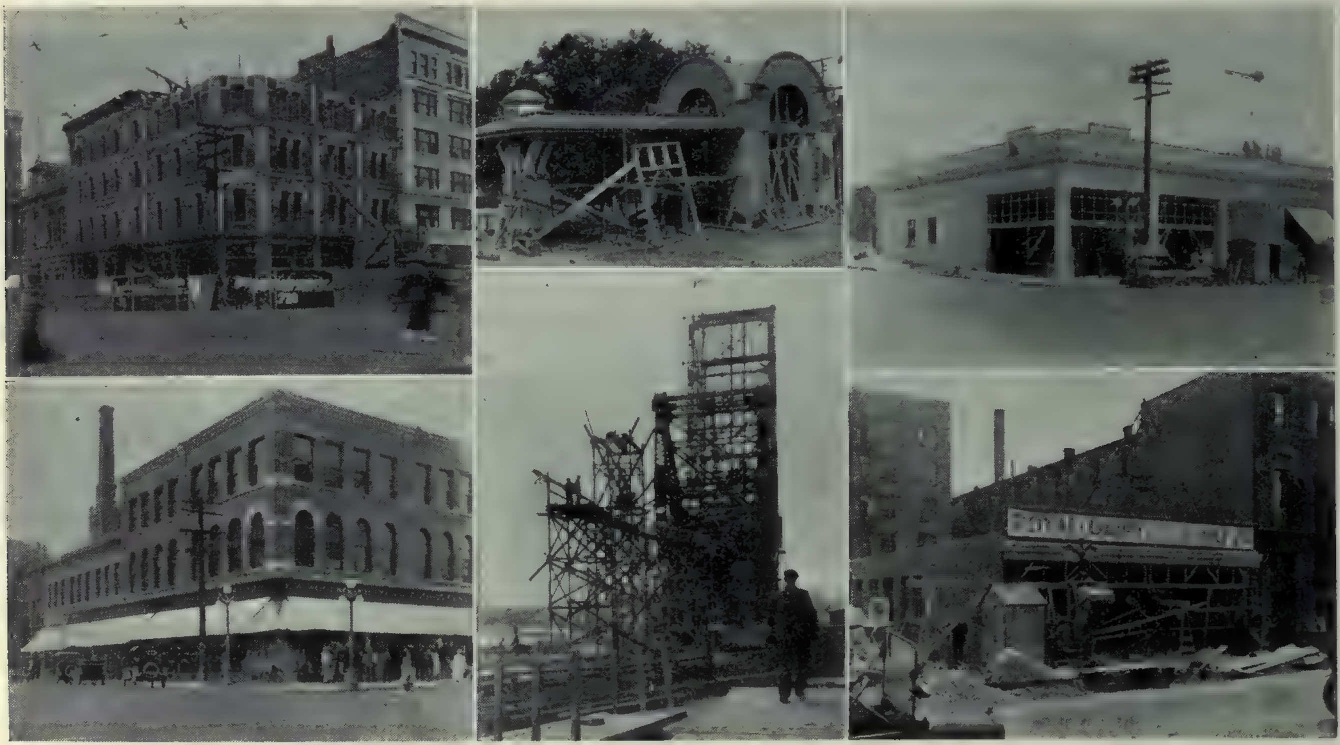
At the present time Hamilton has four sewage disposal plants, the oldest of which has been in use for twenty-five years. All of them are working in a more or less unsatisfactory state and for some time back city officials have felt that this whole matter would have to be thoroughly investigated. In considering the question of appointing a consulting engineer the special Sewage Disposal Committee interviewed four Canadian and two United States engineering firms and, the City Council finally decided to place the work in the hands of Gore, Nasmith & Storrie, consulting engineers, Toronto. A thorough investigation of all the existing conditions will be immediately undertaken and a complete report submitted to the City Council. As soon as this has been done the necessary by-law will be placed before the citizens and it will then be decided whether the whole or any portion of the work will be placed under actual construction. Hamilton at the present time has a population of 120,000 and has one of the finest natural harbors on the Great Lakes. It is the intention of the Hamilton authorities not only to develop the harbor but to maintain the water in a safe condition.

Building Activity in Victoria, B. C.

More Commercial Construction in Progress Now Than for a Number of Years Past—Several Old Buildings Are Being Remodelled, While New Structures Are Plentiful

There is at present more building in progress of commercial nature in Victoria, B. C. than has been the case for a number of years past, a condition which indicates that the far western city is sharing in the general revival of trade now generally admitted to be in progress throughout the country.

The work in hand, while it includes a good deal of remodelling of old buildings, also includes a number of new structures. One of the most important of these, upon which a start is now being made is a three-storey bank building for the Bank of Nova Scotia, on the north-east corner of Yates and Douglas Streets, one of the most important business locations in the city. Plans of the new building have not as yet been filed, although the work of demolition of the old structure existing on the site, a four storey brick and frame building dating from 1886, has commenced. Sol. Cameron, general contractor of Vancouver and Victoria, is in charge of this portion of the work. The new bank is expected to cost in the neighborhood of $250,000 and will be a very handsome addition to the business area of the city. A. A. Cox, Vancouver, is the architect.



Construction Activities in Victoria, B.C.

Top left:—Work commencing on site of new Bank of Nova Scotia, the old building dates from 1886. Top centre:—Gasoline station for Imperial Oil Ltd. Top right:—Block of three stores being erected at the corner of Douglas and Fishguard Sts. Bottom left;—Woolworth store practically completed. Bottom centre: Concrete mixing and lifting plant with runway for pouring counterweight on the Johnson St., bridge. Bottom left:—One storey dairy building on View St.

New Block of Stores

On the corner of Douglas and Fisguard Streets, Messrs Luney Bros., contractors of Victoria, are erecting a block of three stores on a site which has remained vacant for many years. The new building practically completes the filling up of the frontage of this portion of Douglas Street, which has sprung into activity from a business standpoint coincidently with the opening of the large department store of the Hudson's Bay Company, which occupies the block between Fisguard and Herald Streets on Douglas St., directly east of the building now under construction. The new building is one storey, of brick construction, and is being faced with a light buff brick which gives a handsome effect. The electrical work is in the hands of the Sun Electrical Company. C. E. Watkins, of Victoria, is the architect for the building, the contract price for which is in the neighborhood of $18,000.

The contracting firm of Luney Bros., contractors for the above building, are very busy at this season, having several other jobs of varying size on hand. They are now engaged in putting the finishing touches to the handsome new store recently acquired by the F. W. Woolworth Company, the preliminary work on which was described in a recent issue. (May 24, page 497). The lower floor of the building purchased by the Woolworth Company on the corner of View and Douglas Streets has been completely remodelled and modernized, and the result is one of the handsomest stores in the city.

All interior woodwork in the store is finished in mahogany, with plate glass counterfronts and partitions. Floors are maple, in natural finish, and the walls are in shades of light buff, with moulded panels enclosing the Woolworth monogram. The ceiling and exposed beams are finished with stamped metal fireproofing, coated with white enamel. Mirror glass is used to enclose the few columns visible in the store area to half height, with buff tinted plaster above.

The display windows carry out the scheme of the interior, being finished with mahogany molds surrounding mirror glass panels. A number of cast iron pillars occur in the window space and these are enclosed in mirror glass like those in the store area. Oak parquet flooring is used for the windows. Curved plate glass is used to make the returns at all street entrances.

Percy Fox is architect and Luney Bros. are contractors for a dairy building being erected on View Street, near Douglas Street, at a cost of $8,500 for the H. M. Brown Estate. This is a one storey building of brick, with concrete floor, and is being erected under pressure, as it is required for early occupation. The same architect and contractors are also concerned in the re-erection of the Arcade Building, recently partly destroyed by fire. The contract price in this case is about $93,000 and the work is commencing at once.

Parfitt Bros., another prominent Victoria firm of contractors, are also fully engaged at present, having in hand in addition to the new wing of the Provincial Hospital, which has been mentioned several times in the "Contract Record" since work was commenced, an extensive job of remodelling an old building near the corner of Yates and Langley Streets, in the wholesale district. The work which involves the practical reconstruction of portions of the building, is under the superintendence of Percy Cox, architect, and the contract price is $8,500. Parfitt Bros. are also engaged on a sub-contract for the construction of the concrete counterweight for the bascule span of the Johnson Street Bridge. A good deal of intricate form work and steel placing is included in this work, which is further complicated by the necessary requirement that the counterweight must be carried quite independently of the bridge structure, special piles having to be driven for this purpose. The contract price was about $10,000 and the stage of pouring the concrete has been reached.

Artistic Service Stations

The Imperial Oil Company is at present engaged in the erection of four gasoline service stations of unusual and artistic design, the plans for which were drawn by Messrs. Townley & Matheson, architects of Vancouver. These are estimated to cost about $4,000 each and will be quite unique in appearance. The construction is of brick and heavy timber, and is suggestive of the California mission in type. An uncommon feature, indicative of the quality of workmanship going into these stations, is the fact that sheet copper is being used as a roofing material. The four stations will be located at the corners of Quadra and Vancouver, Gorge and Government, Fairfield and Moss, and Oak Bay and Fort Streets, respectively. A service station, at a cost of $25,000, to work in connection with the street stations described, is also planned by the Imperial Oil Company and will be erected at an early date.

An Equipment Lease That Aims to Eliminate Misunderstandings

A Form Adopted by the Executive Board of the Associated General Contractors of America—Avoids Disagreements Incident to Renting Equipment Under Unsuitable Arrangements

An equipment lease that constructors are willing to sign as either lessee or lessor has just been issued by the Associated General Contractors of America. Its object is to establish on a basis of common equity those obligations and responsibilities properly involved in renting construction machines, and to provide a simplified rental agreement which will insure fairness to both parties. Thus a principle universally acknowledged and generally applicable, though too infrequently followed in the construction industry, will be given a practical test.

The form adopted is the result of investigations and criticism of members of the A.G.C. extending over a period of two years. It was prepared under the direction of the Committee of Methods, of which A. P. Greensfelder, Secretary of the Fruin-Colnon Contracting Co., St. Louis, was chairman, and Ward P. Christie, research engineer. Through use of this form it is believed that many difficulties incident to renting construction equipment can be eliminated.

Responsibilities Defined

Both construction and equipment leasing companies have frequently been subjected to expense and annoyance on account of misunderstandings which arise when equipment is rented by verbal or letter agreement or by an unsuitable form of lease, and it is to overcome such difficulties as these, as well as to eliminate drastic and unreasonable provisions, that the new standard form has been adopted. Misunderstandings frequently arise from the fact that equipment is sometimes rented on short notice when the need arises, and when the main consideration is to get the machine into operation. In such instances, a telephone call, a letter or almost any kind of a lease, may serve to close a transaction, and when the unexpected happens both parties find that the responsibilities are not properly defined or that one or the other is saddled with an unfair obligation.

Situations of this nature can usually be avoided where the construction company has a suitable form of lease, easily filled out and familiar to its official and executives. When all companies are using the same form the chance of misunderstanding is more remote, especially when arrangements for leasing must be hurriedly made by letter or wire. This means of consummating an agreement, however, can be safely used by means of the A. G. C. equipment rental agreement. All that is required is an understanding that certain equipment is shipped under A. G. C. terms of lease, and each party will then know definitely his obligations. Final arrangements can be made with a minimum of delay.

The standard form is arranged so that all blank spaces for filling in of dates, rental rates and other stipulations are segregated on the front of a single sheet, and those provisions of general application and requiring no filling in for ordinary conditions are segregated on the back. Thus a concise form of letter size convenient for filing is afforded.

The wording of the agreement with the general conditions of lease are as follows:—

Equipment Rental Agreement

This Agreement, Made the.........day of...... in the year nineteen hundred and....by and between ....hereinafter called the lessor, Witness, that the lessee and the lessor for the considerations hereinafter named agree as follows:

Under the general conditions of lease printed below, the lessor hereby leases to the Lessee all equipment named and identified in the following list of equipment, for use at such location, at such rental rate and for approximately such time as is therein stated; and shall furnish such equipment free on board..........

(Lessor's Carrier, lessee's carrier, or name of railroad)

.... at ....

in good operative condition, with all necessary tools peculiar to the equipment and not standard, but without extra cable, sheaves, bolts or small parts.

LIST OF EQUIPMENT

Description of Equipment	Equipment To Be Used At or Near	Approximate Rental Period See Art. 5	Manufacturer's Shop Number	Lessor's Identification Number	Value of Equipment	Rental Rate Per Article of Equipment

The lessor and the lessee for themselves, their successors, executors, administrators and assigns, hereby agree to the full performance of the covenants herein contained.

In Witness Whereof, they have executed this agreement the day and year first above written:

....
Witness. Lessor.
By.............

....
Witness. Lessee.
By.............

General Conditions of Use

The conditions of lease here below stated, together with the agreement set forth above, constitute between theparties therein named a contract which is hereafter referred to as this agreement.

1. **The rental period.** The rental period shall begin on and include the date of either legal delivery of the equipment to the lessee or his agent, or legal delivery to a public carrier for transit to the lessee; and shall end on and include the date of either legal delivery of the equipment to the lessor, anothed lessee or an agent of either, or legal delivery to a public carrier for transit to the lessor or another lessee.

2. **Determination of rental charges.** The lessee shall pay rental for the entire rental period on each article of equipment named in the list of equipment, at the rate therein stipulated and in accordance with the following:

(a) **Monthly Rental Rates** shall not be subject to and deductions on account of any non-working time in the month, but the amount of rent payable for any fraction of a month at the beginning or end of the rental period shall be the monthly rental rate, prorated according to the number of calendar days in such fraction.

(b) **Daily Rental Rates** shall not be subject to deductions for any non working time in the day and shall be paid for each calendar day in the month except Sunday and legal holidays upon which the equipment is not operated.

Daily and monthly rates stipulated in the list of equipment contemplate an operating day of ten (10) hours, and for each hour over ten that the equipment is regularly operated these rates shall be increased four (4) per cent. throughout such period as the equipment is so operated.

(c) **Unit of Work Rates** shall be paid for each unit of work in which the equipment participates, and the amount of rental shall, unless otherwise agreed in writing, be determined by the number of units shown in the supervising engineer's or architect's estimates.

3. **Payment.** The lessee shall pay to the lessor as the minimum amount due under this agreement, two (2) per cent. of the value as shown under list of equipment of each article of equipment, and shall pay as the minimum rental on each such article, loaded for transit to the lessee, four (4) per cent. of such value

The amount of rental accruing each month shall be paid on or before the fifteenth of the following month at the office of the lessor or such other place as may be mutually agreed upon.

Deferred payments shall bear interest at seven (7) per cent., but the payment of this interest shall not waive the lessor's right as hereinafter stipulated to terminate this agreement.

4. **Loading, Unloading and Transportation.** The lessor, at his own expense, shall load the equipment for transit to the lessee and upon its return unload it, and shall pay all demurrage charges accruing at his own shipping or receiving point. The lessee, at his own expense, shall do all other loading, unloading, installing, dismantling, and hauling, and shall pay all demurrage accruing at his own shipping or receiving point, and all freight and switching charges.

The lessor may ship the equipment in accordance with his own judgment if shipping instructions are furnished within seven (7) days from date of this agreement.

5. **Recalling and Returning Equipment.** The lessor may recall any or all equipment upon thirty (30) days' written notice to the lessee and the lessee may return any or all equipment upon a like notice to the lessor.

6. **Maintenance and Operation.** The lessee shall not remove, alter, disfigure or cover up any numbering, lettering or insignia displayed upon the equip-

ment, and shall see that the equipment is not subjected to careless or needlessly rough usage; and he shall at his own expense maintain the equipment and its appurtenances in good repair and operative condition, and in such condition return it to the lessor.

7. **Supplying Operators.** Unless otherwise mutually agreed in writing the lessee shall supply and pay all operators employed on the equipment during the rental period, and shall employ none thereon who are incompetent to perform their respective duties. Should the lessor, by agreement, furnish any operators, each shall receive from the lessee such traveling expenses, board, lodging, and wages as the lessee and the lessor may agree upon in writing.

8. **Damage to Equipment.** The lessee shall indemnify the lessor against all loss and damage to equipment during the rental period and the appraisal of any such loss or damage shall be based on the equipment values shown by the list of equipment. Any shortage or damage claim of either party shall be made known to the other party within seven (7) days after receipt of equipment, or such claim shall be void.

9. **Repairs.** The lessee shall pay the cost of rerolling old boiler tubes and of all other repairs and renewals, except that if, in any calendar month, more than seven (7) per cent of the total number of such tubes should, under reasonable care, require replacement, the direct labor and material cost thereof over and above that of the seven per cent. shall be borne by the lessor.

10. **Liability of Lessee.** The lessee shall indemnify the lessor against all loss, damage expense and penalty arising from any action on account of personal injury or damage to property occasioned by the operation, handling or transportation of any equipment during the rental period.

11. **Inspection.** Before the equipment is loaded for transit to the lessee, he may require an inspection thereof by proper authorities, and if the equipment is not in substantially the condition required by this agreement the cost of inspection shall be paid by the lessor.

The lessor shall have the right at any time to enter the premises occupied by the equipment and shall be given free access thereto and afforded necessary facilities for the purpose of inspection.

12. **Title.** Title to the equipment shall at all times vest in the lessor unless transferred to the lessee through sale. The lessee shall give the lessor immediate notice in case any equipment is levied upon or from any cause becomes liable to seizure.

13. **Termination of Agreement.** Should the lessee defer any payment more than thirty (30) days, or become bankrupt, or fail to maintain and operate or to return the equipment as provided by this agreement, or substantially violate any provision thereof, the lessor may, after three (3) days' notice, terminate this agreement, take possession of the equipment without becoming liable for trespass, and recover all rental due, full damages for any injury to, and all expense incurred in retaining the equipment.

Should the lessor fail to ship the equipment in substantially the condition stipulated by this agreement, or within ten (10) days from date thereof, or substantially violate any provision thereof, the lessee may, upon three (3) days' notice, terminate this agreement, recover all sums paid the lessor, and in case of shipment not in operative condition as specified may return the equipment at the lessor's expense.

14. **Insurance.** The lessee shall, at his own expense, maintain fire and other insurance, if requested by the lessor.

15. **Bond.** The lessee shall, if requested by the lessor, furnish a bond in amount of the value of the equipment as shown by the list of equipment, and with sureties satisfactory to the lessor, to insure fulfillment of this agreement.

16. **Sub-Letting.** No equipment shall be sub-let by the lessee, nor shall he assign or transfer any interests in this agreement without written consent of the lessor.

17. **Purchase of Equipment.** Should the total continuous rental paid by the lessee for any units of equipment amount to one hundred and fifty per cent. (150%) of the value thereof as shown by the list of equipment, no further rental shall be paid on such units and the title thereof shall vest in the lessee, and he shall have the right at any time upon thirty (30) days' notice to purchase any equipment by paying the difference between the total continuous rental already paid and one hundred and fifty per cent. (150%) of the value—payment of such difference to be made upon such terms as the two parties may decide.

Reflooring of Granville St. Bridge

(Continued from page 779)

exception that somewhat heavier timber is now being used than was previously installed to take care of the increasing weight of traffic, and that creosoted lumber is being used throughout. The work is proceeding day and night, as it constitutes a serious hindrance to traffic. It is expected to cost about 40,000.

Face to Face With Prosperity

Winnipeg, July 20.—Grain companies, mills, railroads and the Lake Shippers' Association are just now feverishly preparing to handle what is expected to be the largest grain yield in the history of the Canadian Northwest. Rolling stock is being borrowed from eastern divisions and the banks are accumulating surpluses of cash at small branches from the lakes to the mountains in preparation for the big movement.

Official statistics from the grain exchange show the wheat acreage of the three provinces to be 21,146,000. In 1915 the acreage was 13,867,715. The average yield per acre then was 25.97 producing a yield of 360,187,000 bushels. The most optimistic, however, does not anticipate a yield so high this year. For ten years, however, the average has been 17 bushels. Upon this basis the yield this year would be 359,822,000 and this is the minimum that well informed sources expect will be produced.

The question on October wheat, say July 10, 1915, $1.03\frac{3}{8}$. July 10 this year October wheat quotation was $1.16\frac{1}{4}$. On the basis of this quotation this year's crop ought to yield at Ft. William, $417,393,500 or in cash, $47,250,000 more than the famous 1915 crop. The amount that would reach the farmers' hands would be, in cash, $327,438,000 because it costs 18 cents freight and six cents elevator charges per bushel to handle to head of the lakes. Approximately this amount of cash will be released through ordinary business channels in the west this fall.

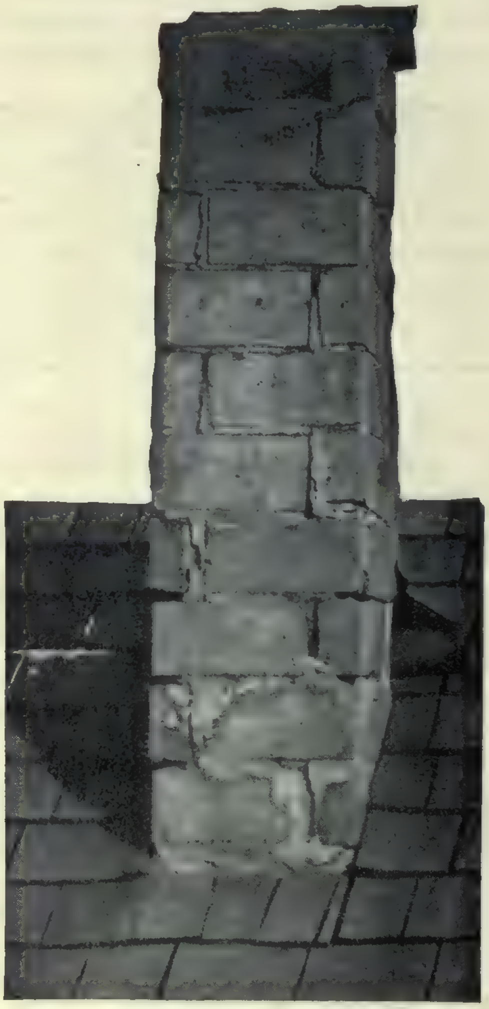
Of course this is a debt-paying crop, but if conditions today continue it means that the books will be cleaned and all paper liquidated.

Defective Flues and Chimneys Are a Serious Fire Hazard

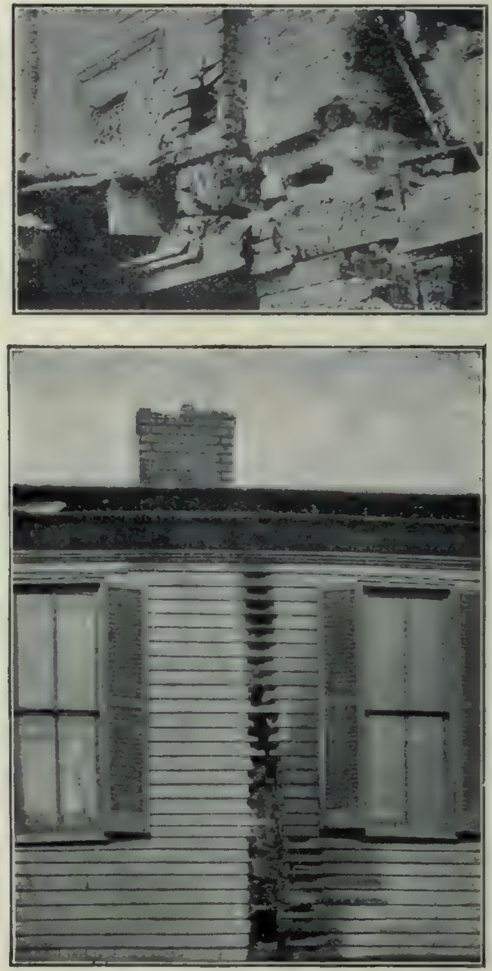
Unsafe Chimney Construction is of Common Occurrence—Adoption of N. B. F. U. Ordinance will Reduce the Losses from this Cause by Insisting on Sound, Fire-safe Flue Design

By A. G. DALZELL, M.E.I.C.

Defective flues and chimneys are classed as one of the major causes of fire by the National Board of Fire Underwriters of New York. In their publication "Safeguarding America Against Fire" it is stated that "of the four divisions into which heating plants are divided in the list of fire causes drawn up by the actuarial bureau of the National Board of Fire Underwriters, that of defective chimneys and flues is responsible for the heaviest property losses. It stands third in the list of major fire causes.



Chimney built with brick on edge, typical of much careless construction in many small communities.



Upper—Floor joist built into brick-work of chimney— a frequent cause of fire.

Lower—How defective flues start fires. If the defect had been on the inside the whole building would probably have been destroyed.

"During the six years from 1915 to 1920 this "strictly preventable" fire hazard was the cause of $71,037,084 worth of material wealth being destroyed. Allowing 25% for unreported losses and those upon uninsured property, the total is increased to $88,796,355 which is considered a conservative estimate of the losses."

It is probable that no single fire hazard affects the home and family more closely than the defective chimney and flue, yet hundreds of thousands of such chimneys and flues are in existence and new ones are being built every day upon unsafe specifications. The situation is particularly serious in rural communities where fire protection is scant or entirely lacking.

People do not intentionally live in dwellings harboring a constant danger of this kind; one that may result in their being forced to seek the safety of the street on some icy winter's night. The fault lies in the natural ignorance of the average citizen as to what constitutes a safe chimney and flue, and in the contractor or builder who introduces into homes such structural designs as unlined brick-on-edge chimneys, those suspended by brackets, those supported on wooden beams, or chimneys that are otherwise defective. Protection against such hazardous building practice which the public might reasonably insist upon lies in the enactment and enforcement of building bylaws to secure construction of chimneys.

The National Board of Fire Underwriters, as a guide to the preparation of such by laws, has prepared a chimney ordinance the most complete of its kind ever published. This ordinance hears the endorsement of twelve large national organizations associated with the building industry and thus has a certificate for correctness and suitability which has not been accorded to any similar set of specifications hitherto prepared. There is a great need in Canada, as in the United States, to reduce the enormous fire loss. The average loss per head of population is five times that of European countries and correspondingly large sums are spent on fire brigades and fire fighting equipment involving burdensome municipal taxation. Notwithstanding this expenditure the premium to insure against loss by fire is greatly in excess of that in other countries. Reduction in fire loss can best be secured by better methods of building construction and greater care in the use of fire.

When causes of fire are so clearly pointed out by competent authorities and confirmed by impartial statistics it is surely criminal carelessness to continue to build in the same haphazard way. Most municipal authorities now consider that it is necessary to submit the plumbing of buildings to smoke and water tests, but the damage or loss of life occasioned by a slight escape of sewer gas, which is now known to be not nearly so dangerous as was once imagined, is as nothing compared to the loss of life and damage by fire. If the average chimney was submitted to the same smoke test as the plumbing some surprising results would be disclosed.

Reflooring of the C. P. R.'s Granville St. Bridge at Vancouver, B. C.

Old Wood Floor is Being Replaced by Heavier Timber to take Care of Increased Traffic—Creosoted Lumber is Used—Work is Proceeding Speedily

By J. B. HOLDCROFT, A.M.E.I.C.
Contract Record Correspondent

A rush job now being handled by the Nickson Construction Co. Ltd., of Vancouver, B. C., is the reflooring of the Canadian Pacific bridge making connection with the company's pier "D" at the foot of Granville St., Vancouver. The bridge spans the main line tracks of the C.P.R. passenger station, and tracks connecting the ocean docks with the freight yards. It comprises two half-through plate girder spans, each consisting of two roadways, separated by the inner girders which projected about four feet above the level of the roadway. The approaches are fan-shaped, of structural steel construction, and are carried from the track level by latticed columns with concrete bases.

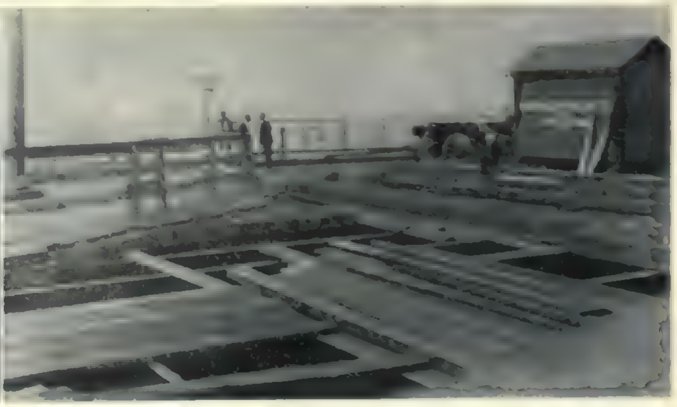
The floor on the plate girder sections, and on the south or Granville Street approach is carried on 6" x 18" cross joists which in turn rest upon the steel floor system consisting of longitudinal I-beams riveted to the main cross beams. The floor itself is of 3" x 9" plank, spiked to the joists. Over this will be a seal coat and wearing surface.

The north end approach, which leads to the landing floor and offices of pier "D", and which is sufficiently large to accommodate taxis and hotel buses, is being floored with 2" x 10" sections spiked together, making the familiar "laminated" construction. It will be surfaced in uniformity with the part already described.

The new work follows closely the method originally used for floor construction on this bridge, with the

(Continued on page 777)

Removing old decking from C.P.R. bridge on Granville St., Vancouver, B.C



Replacing old 2 by 8 laminated decking with 2 by 10 decking on approach to dock shed of C.P.R. pier D

Hydro-electric Development at Cameron Falls, Nipigon River, Ontario

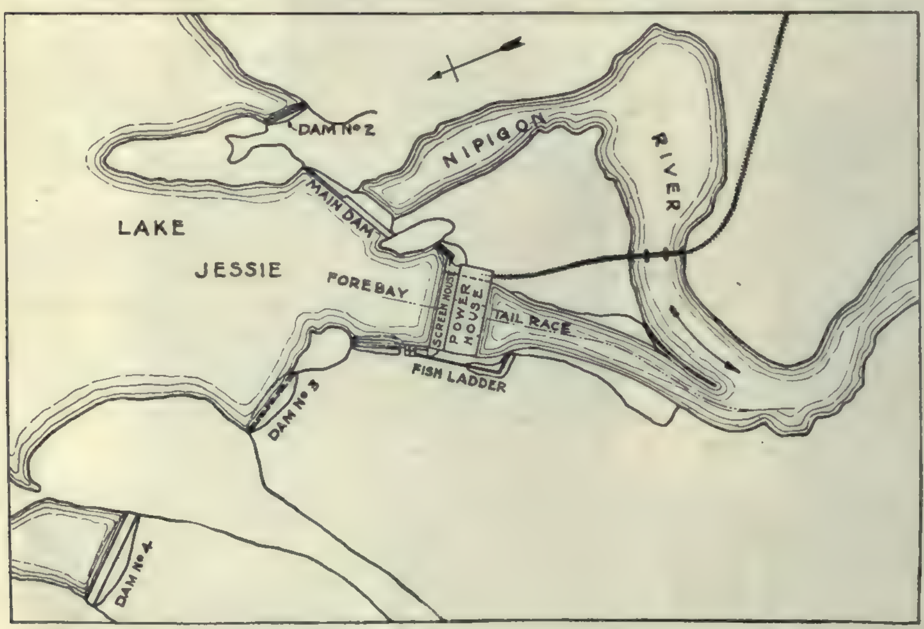
The First Two Units of an Ultimate Capacity of Six Totaling 75,000 Horse Power, Installed. Head Gates and Power House Foundations Completed for Full Capacity

The Nipigon river is an admirable stream on which to develop power. The river drains an extensive area and has a large annual run-off, which, due chiefly to the large and effective storage in lake Nipigon, may be controlled so as to give an unusually uniform discharge throughout the year. Moreover, the condition of the banks is such that the total fall in the river, from lake Nipigon to lake Superior, of 250 feet, can be concentrated at three or four power sites.

The Cameron Falls plant is situated at the lower end of lake Jessie, an expansion of the Nipigon river, which, being a large still reservoir, freezes completely over in the early winter and by thus providing an ice cover until the spring break-up, prevents the formation of the troublesome frazil and anchor ice.

The present development with its 78-foot head and capacity of 75,000 horsepower is completed for two units of 12,500 horsepower each. These are now delivering power to Port Arthur. The head works and power house foundations are completed for the ultimate installation of six 12,500 horsepower machines.

At Cameron Falls, nature has provided a convenient site where the power works may all be concentrated within a small area. In general, it may be explained that the power plant is formed by the construction of a dam across the Nipigon river at the lower end of lake Jessie and the excavation of short head-race and tail-race channels across the point of land formed by a bend in the river.



General plan of power development at Cameron Falls, Nipigon River, of which the first two 12,500 h.p. units, out of a total of 6, have just been installed by the Hydro-electric Power Commission of Ontario.

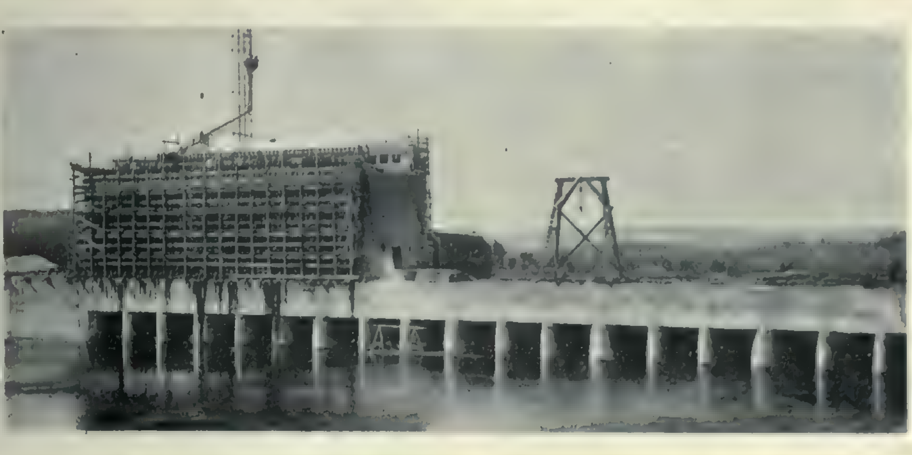
The Dam

The dam across the river is a solid, concrete, gravity-type structure, provided with eight spillway sections adjustable by means of stop logs for the regulation of the flow of the river. The stop logs in the sluiceways are raised or lowered by means of an electrically-operated winch which moves along an operating platform constituting a deck over the top of the spillways. The maximum height of the dam in the centre of the river is 67 feet.

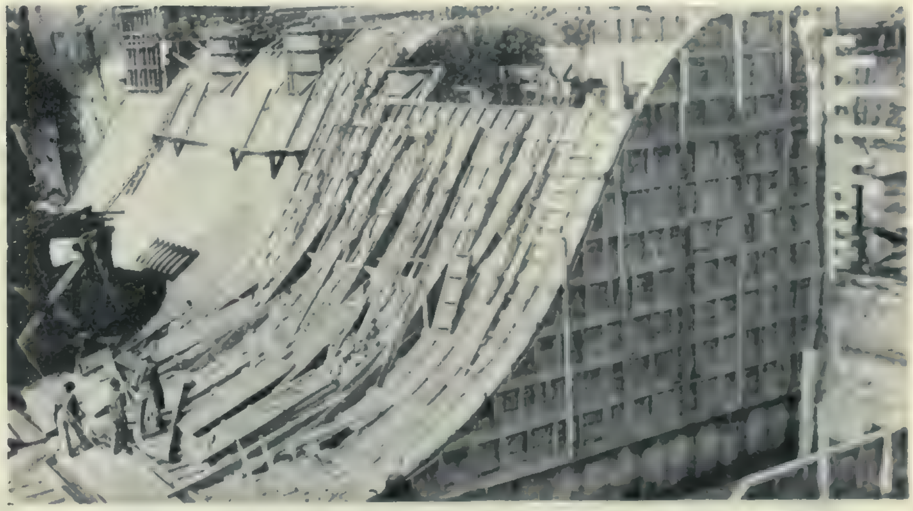
The Power House

The power house is of the concentrated type of construction in which the gate and screen house, the penstocks, and the transformer station all form part of the same structure. Although the superstructure for the gate house and power house has been completed for only the two units now installed, nevertheless the gate house and also the submerged part of the turbine foundations have been completed for the six units of which the plant will ultimately consist. The gate house is provided with electrically-operated steel gates and in order to prevent trash and ice flowing into the turbines, removable steel screens have been installed. The penstocks are formed in the concrete foundations and are so designed as to deliver the water to the turbines at low velocities, thus insuring a minimum loss. In constructing the scroll cases for the turbines a departure has been made from the usual practice of using cast iron by forming the cases in the concrete. This has proved more economical in construction and gives also more efficient operating characteristics.

The turbines are of the Francis, single-runner, vertical type of 12,500 horsepower each, and operate at a speed of 120 revolutions per minute. They are controlled by the latest hydraulic-type governors, and in addition are provided with an emergency hand control for use in case of any failure in the governors. Each turbine is directly connected to a 10,600 kilovolt-ampere vertical generator which delivers power to the transformers at 12,000 volts. Each generator has its own exciter mounted directly on top of



Head works as they appeared on June 15, 1921.



Dam No. 1 as it appeared on September 19, 1921

General view of the main Dam Nov. 15, 1921

Dam No. 1 from down stream side on Dec., 1921 the main frame thus making each machine in itself a complete unit.

Travelling cranes are installed in both the gate house and the generating room; the former for use in operating the screens and the latter for effecting repairs to the main power units as well as for erection work.

The Fishway

Every year visitors from many parts of the world are found along the shores of the Nipigon river which is justly famous for its trout fishing. The Commission has given thought to the preservation of this sport. A fish-ladder has been provided around the west end of the power house. The design of the ladder has the endorsation of the Provincial Game & Fisheries department, and it is believed that the installation of this ladder has provided a free and satisfactory passage for the fish in their annual up-stream migration.

Electrical Equipment

Turning now from the hydraulic features of the plant to the electrical generating equipment, it may first be commented that in order to completely house the generating, transforming and station service equipment of the ultimate development, a superstructure having an overall length of 311 feet will be required; of this, 130 feet has been erected. The total width of the building from the north wall of the gate house to the south wall of the generating room is 150 feet. The height from the floor of the generating room to the roof of the high-tension room is 87 feet, and from the bottom of the tail-race 147.5 feet.

Interior view of Nipigon Power Station showing High Tension Switches and Arresters.

The superstructure has been built throughout of high-grade fire-proof materials, the framework being of steel, with walls, floors and structures for the electrical apparatus, of reinforced concrete. The ultimate development is for six generators with total capacity of 75,000 horsepower.

The generators, of which there are already two installed, are rated at 10,600 kv.a., 80 per cent. power-factor, 3-phase, 12,000 volts, 60 cycles. They are 26 feet in diameter. The rotors revolve at 120 revolutions per minute, corresponding to a peripheral speed at face of pole pieces of 7,917.5 feet or 1.5 miles per minute.

The weight of the total rotating part including the direct-connected exciter—which is connected to main shaft above the thrust bearing—the rotor complete, the turbine and the shaft, is approximately 125 tons, all of which is carried on a thrust bearing mounted on top of the upper bracket of the generator proper. This thrust bearing is 46½ inches in diameter and is designed to sustain a weight of 385,000 lbs. It is lubricated by mineral oil having a viscosity of 250 seconds at 100 degrees F. and is cooled by water circulating through a number of coils immersed in the oil.

The generators are air cooled, the air being drawn into the generating units through concrete ducts, either from the outside of building or from the generator room. The flow of outside air is controlled by dampers operated from the floor of the generator room. Each generator, when operating under normal load, requires 55,000 cubic feet of air per minute. The weight of the amount of air thus required in two hours and ten minutes would equal the weight (262.5 tons) of a complete generator.

The station is equipped with a 75-ton electric travelling crane which is capable of handling the heaviest parts of the generator.

The electric power from the generators passes through 12,000 volt, oil circuit-breakers, to a duplicate bus, then to a bank of three, 8,000 kv.a., oil-insulated, water-cooled transformers where the voltage is stepped up to 110,000 volts. From these transformers, the power passes into the high-voltage room where it passes through the high-voltage oil circuit-breakers and buses, then out of the south side of the building where it is connected to the transmission line.

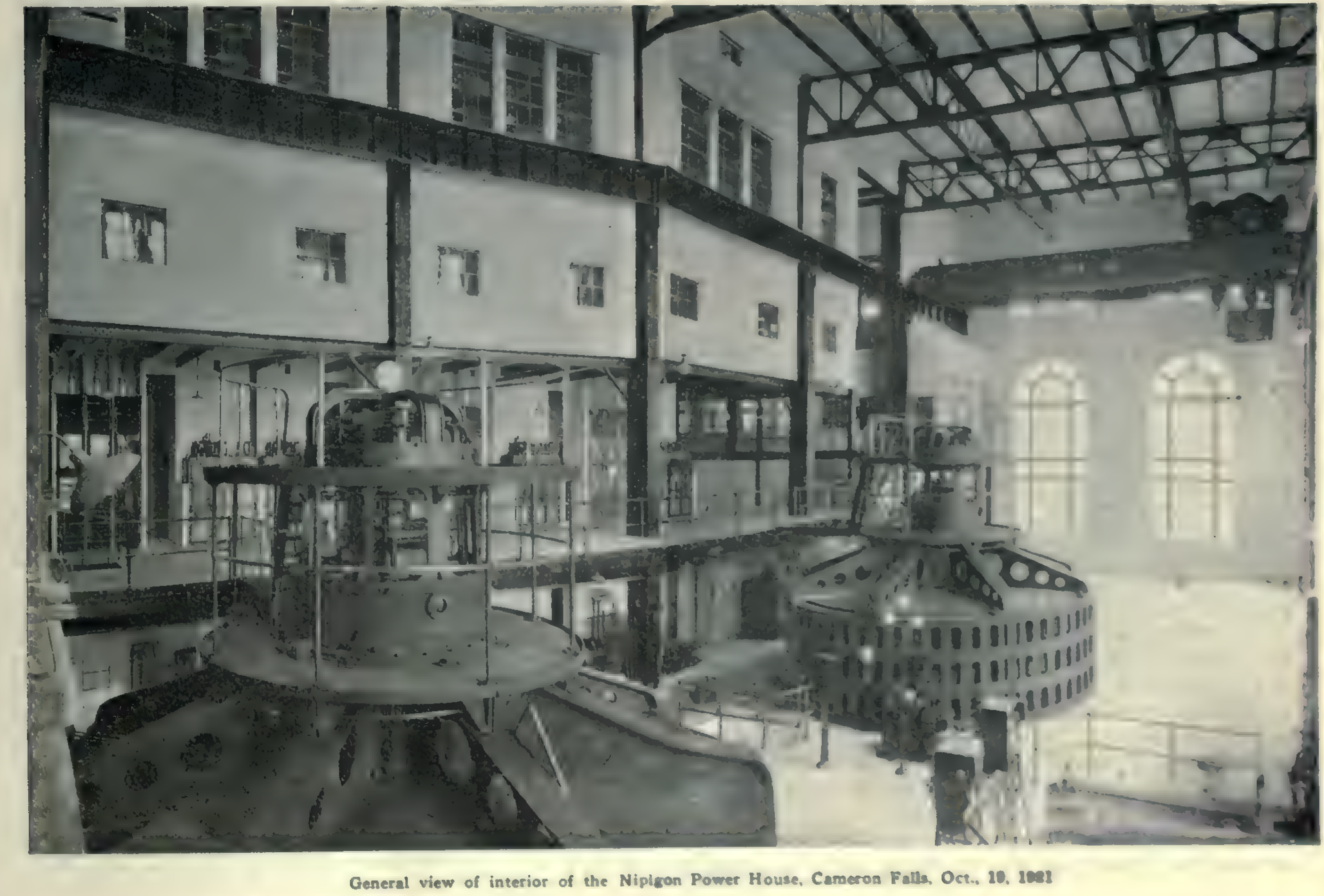
The power for the governor pumps, motor-generator sets, station lighting, elevator, etc., is taken from the 12,000 volt generator buses to a bank of three 250 kv.a. transformers where the voltage is stepped down from 12,000 to 575 volts. From these transformers this power is carried to a station service control-board whence it is distributed throughout the station. The control room is located at the east end of the station on the first floor of the control bay, and from this room the entire station will be controlled. Each section of the power house consists essentially of two generators, their bank of transformers and a transmission line. The switching equipment is such that any of the three sections of the power house may be separately operated or else operated in combination with either of the other sections.

A stair-way and an automatic electrically-operated elevator afford access to the seven floors.

In the basement are two 3,000-gallon, oil storage tanks, one for transformer oil and the other for switch oil. There are also two 2-inch centrifugal, 250 g.p.m. pumps for the water cooling system for the generator bearings and transformers. These pumps have a sufficient capacity for the water-cooling system of the ultimate development. In addi-

General view of Dam and Power-house September 19, 1921.

General view of development as it appeared on September 26, 1921.



General view of interior of the Nipigon Power House, Cameron Falls, Oct., 19, 1921 tion there is one 2-inch centrifugal 50 g.p.m. pump for domestic water supply to the operators' cottages and one 3-inch centrifugal pump of 250 g.p.m. capacity against a 300-foot head for the fire protection of this station. Then there is the lubricating oil filter-tank which has a capacity of 3,667 Imperial gallons per hour. This is in series with the lubricating oil system for the generators and is capable of filtering oil from all the generators of the ultimate development. Alongside of this filter tank is an installation of two 2½ inch centrifugal, oil pumps of 75 g.p.m. These lift the oil from the filter tank up to the lubricating oil reservoir tank on the fourth floor. The oil from generator bearings feeds by gravity into the filter tank from which after being filtered it is pumped up into reservoir tank whence, by gravity, it is again fed to the generators.

Between the generator room and the transformer room is the 12,000 volt switch gallery with the 12,000 volt bus room and the high-voltage room above.

In the rear of the low-voltage gallery and extending the full length of the power house is the transformer room. At present there has been installed a bank of three 8,000 kv.a. transformers, also a compartment containing the three service transformers. To the rear of this building is the gate house.

On the west bank of the tail race, five houses have been erected for the operating staff, one of seven rooms and four of six rooms each. An additional house of eight rooms is yet to be erected. In addition there are three houses erected which were used for the construction staff but which will be retained for use of the operating staff.

Port Arthur Transformer Station

Eventually a permanent inter-city transformer station will be erected in a suitable situation, but in the meantime a temporary transformer station consisting of a building 67 feet long by 40 feet wide and 30 feet high, built of a wooden frame work with gunited cement walls has been built at Bare Point. On entering the building, the 110,000 volt power is carried through a high-voltage, oil circuit-breaker to a bank of three 4,000 kv.a. transformers where the voltage is stepped down from 110,000 to 22,000 volts at which potential power is delivered to the city of Port Arthur.

Progress of the Work

On the 1st of December, 1918, a small gang of men, by cutting and piling brush, commenced the work of clearing. On February 3rd, 1919, track was being laid from the Canadian National Railways' line to the camp site, on the 13th of March work was commenced on a temporary power house, and on June 6th, hand drilling and excavation commenced on the Cameron Falls power-house site. In the latter part of July, shovels were excavating the tail-race and the power-house site. On May 13th, 1920, the concrete footings were commenced for draft tubes Nos. 1 and 2. Portions of the physical equipment for the power-house reached the work in rapid succession. On the 31st of October, the 75 ton crane was ready for operation. On November 3rd the runner and shaft for No. 2 unit was placed in position, on November 5th the corresponding equipment for No. 1 unit was in position, and on December 13th at 8:55 p.m. No. 2 generator was ready for operating to be dried out. On the 16th of December, the transmission line to Port Arthur was phased out, found satisfactory, and at midnight on the 20th of December—just as the power contract was expiring—No. 2 generator was delivering Nipigon hydro-electric power to Port Arthur.

On January 9th, 1921, the final closure was made in the main coffer dam. On the 24th of the same month No. 1 generator was started, and on the 13th of March this generator was satisfactorily parallelled with No. 2. Diversion of water for power thus far was being made by means of the coffer dam with water at elevation producing a head of about 59 feet. On the 12th of April, 1921, drilling was started on the main dam site. On the 12th of August the first concrete was poured on this dam. On the 22nd of October all the auxiliary dams had been completed. On the 25th of November the water in the forebay was raised to elevation 732, on the 28th to 738 and on the 16th of December the stop logs were placed in the main dam in order to bring the water elevation to 745, giving a working head of 78 feet. On the last mentioned date the construction camp was closed and, with the exception of twelve men retained for construction plant repairs and for clearing out the camp, all the men were laid off.

While work was proceeding on the plant at Cameron Falls, other construction crews were busy erecting the transmission line. The clearing of the right-of-way was performed in several sections, the first being commenced on the 19th of May, 1919, on the section extending from the intersection with the Canadian National Railways' line, to Bare Point at the easterly limits of Port Arthur. The work of the erection of the poles was first started on the section from Everart to Pearl on June 2nd, 1919, and the erection of the conductor on the same section on October 6th, 1920. The whole line was in operation on the 20th of December, 1920.

A view of the Nipigon Transmission Line

The main transmission line is 70.36 miles long, and has 1,124 wooden poles. It is designed for 110,000 volts with 4/0 B&S steel-reinforced aluminum conductor and C.P. 2133 O.B. 12464 insulators. The telephone wire is 3 x 13 galvanized steel, and the ground cable 9/32 inch galvanized steel. The line from Nipigon junction to Sprucewood junction and the Nipigon Fibre and Paper Co. is 110,000 volt wood pole construction, 6.67 miles long, with 111 poles. The sizes of conductor, telephone wire and ground cable are the same as in the main transmission line, the type of insulator being C.P. 2133.

Cutting Costs with the Progress Chart

Its Use Insures Orderly Building Operations and Results in a Considerable Saving in the Total Cost—How Records Are Kept by Means of a Progress Chart

By H. N. SNOW

of Hoggson Bros., New York and Chicago, in "The Constructor"

Said an authority on standardization and simplification in industry recently, "the more complex the undertaking the more essential is a schedule." The soundness of this principle is evidenced by the rapidity with which production charts and progress schedules have been introduced in large manufacturing plants and adopted by large corporations.

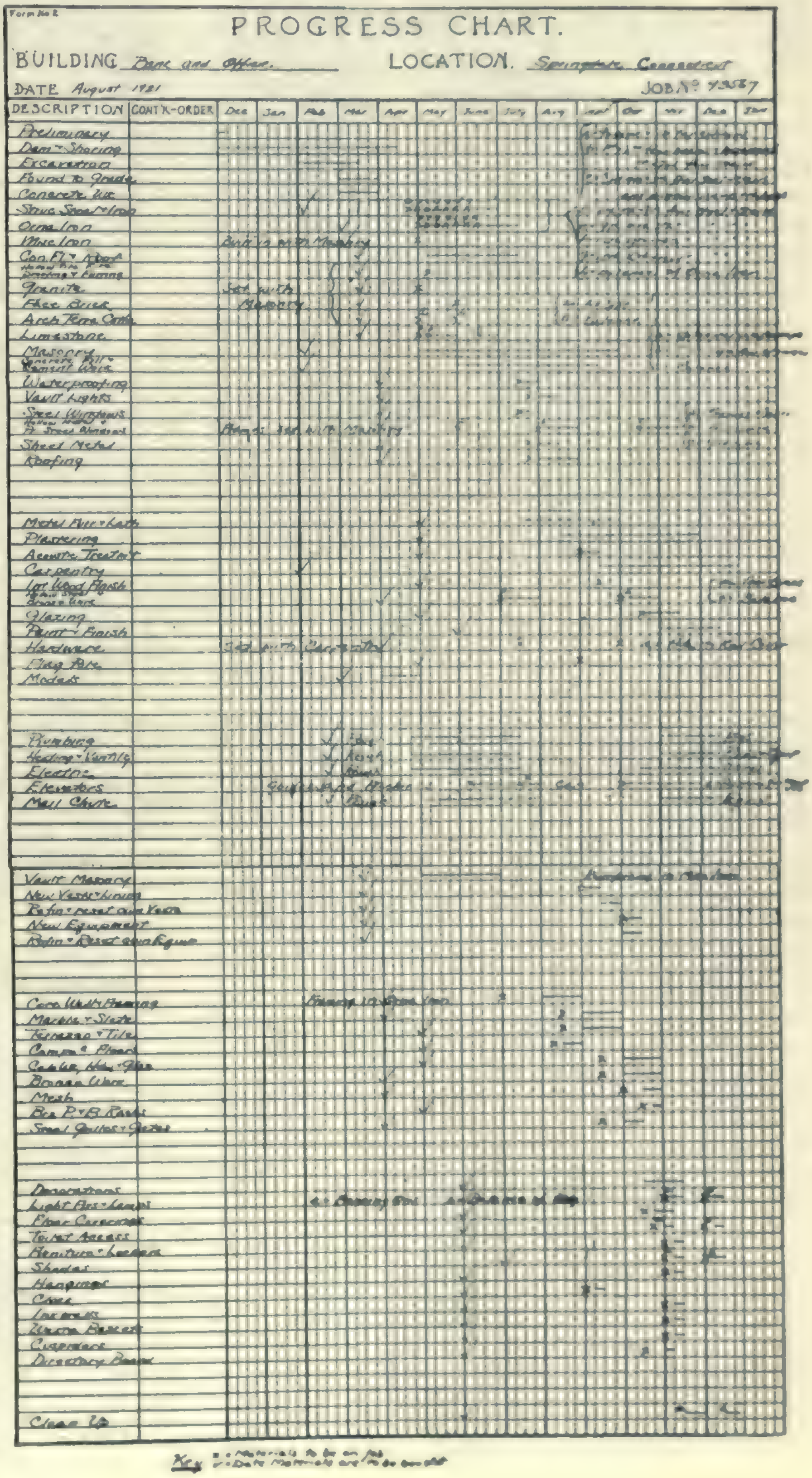
The progress chart has likewise had its place in the work of large building concerns and has resulted in such obvious benefits where used, that its adoption can be strongly advocated for even the smallest operations. Early in Hoggson Brothers' career the need was felt for some orderly visible method of keeping in touch with the progress of a number of operations all going forward simultaneously. Various forms of charts were experimented with, until the form now in use in our construction department was adopted as the one most satisfactory from every standpoint. This progress chart is now used for every one of the company's building projects, from the smallest alterations to the largest bank and office buildings.

Functions of the Chart

With a progress chart an entire building operation becomes an orderly progression of events, each step anticipated, fully prepared for and falling smoothly into its place after the preceding step; the builder being able to estimate accurately the completion date of the job and the owner receiving his building on time.

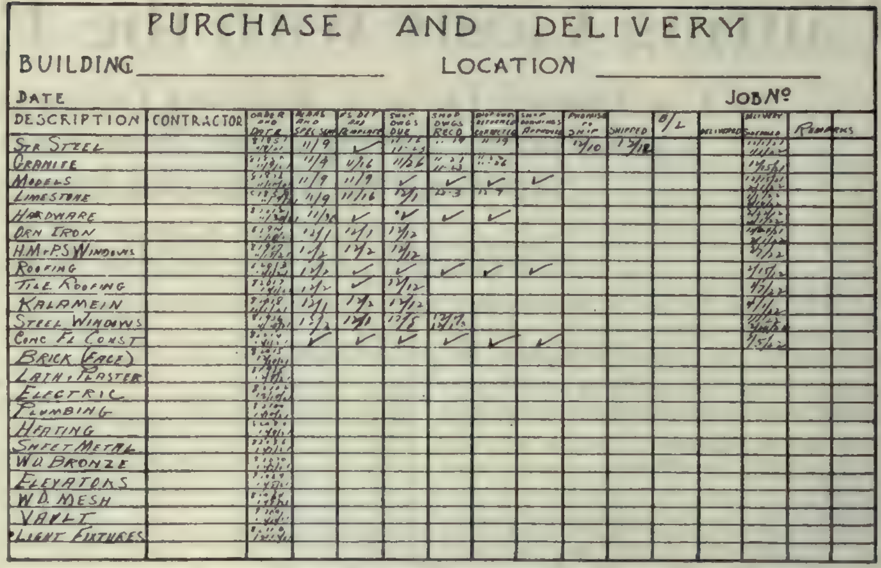
But, most important of all, the greatest advantage of the progress chart is to be found in its money-saving feature. Such a method of controlling a building operation results in a very material saving on the total cost of the operation. To get a clear conception of the way cost can be reduced by means of the chart, it is necessary to state briefly its use.

At the start of each operation, it is scheduled on a chart (Fig 1), which gives specific dates for the completion of all the steps comprising the job. Such a schedule must,



of course, be prepared by one who is widely experienced and familiar with general conditions, as well as the features peculiar to each project. The typical progress chart includes such items as "temporary quarters," "demolition," "structural steel," "masonry." "cut stone," "carpentry," "hardware," "plumbing," "heating," "electrical installation," "floor converings." "lighting fixtures," etc., clear through to the "final cleanup."

In addition to the specific dates for the completion of the various stages mentioned, the progress chart carries delivery dates for all manufactured articles which are to go into the completed building. This is the secret of both the cost-reducing function of the chart and also of its success as a "time table;" for, in order to keep to the building schedule, it is necessary to insure the compliance of the manufactures with their delivery dates. A very integral part of the schedule is the "subschedule" of secondary processes. Therefore, there is scheduled, prior to each delivery date at the site, the required time for the various steps in the manufacture of the finished products. The orders are then placed in plenty of time, the manufacturers followed up at each step and their progress checked against the requirements for delivery on time.



PURCHASE AND DELIVERY

BUILDING ______ LOCATION ______

DATE JOB Nº

DESCRIPTION	CONTRACTOR	ORDER AND DATE	PLANS AND SPEC SENT	F.S. DET AND TEMPLATE	SHOP DWGS DUE	SHOP DWGS REC'D	SHOP DWGS RETURNED CORRECTED	SHOP DRAWINGS APPROVED	PROMISE TO SHIP	SHIPPED	B/L	DELIVERED	DELIVERY SCHEDULED	REMARKS	
STR STEEL		[illegible]	11/9	✓	[illegible]	[illegible]	[illegible]		12/10	12/12			[illegible]		
GRANITE		[illegible]	11/4	11/16	11/26	[illegible]	[illegible]						[illegible]		
MODELS		[illegible]	11/9	11/9	✓	✓	✓	✓					[illegible]		
LIMESTONE		[illegible]	11/9	11/16	12/1	[illegible]	[illegible]						[illegible]		
HARDWARE		[illegible]	11/30	✓	✓	✓	✓						[illegible]		
ORN IRON		[illegible]	12/1	12/1	12/12								[illegible]		
H.M.&P.S. WINDOWS		[illegible]	12/2	12/2	12/12								2/7/22		
ROOFING		[illegible]	12/2	✓	✓	✓	✓	✓					2/15/22		
TILE ROOFING		[illegible]	12/2	✓	12/12								4/7/22		
KALAMEIN		[illegible]	12/1	12/2	12/12								4/1/22		
STEEL WINDOWS		[illegible]	[illegible]	[illegible]	12/8	[illegible]							[illegible]		
CONC FL CONST		[illegible]	✓	✓	✓	✓	✓	✓					4/5/22		
BRICK (FACE)		[illegible]													
LATH & PLASTER		[illegible]													
ELECTRIC		[illegible]													
PLUMBING		[illegible]													
HEATING		[illegible]													
SHEET METAL		[illegible]													
WD. BRONZE		[illegible]													
ELEVATORS		[illegible]													
W.D. MESH		[illegible]													
VAULT		[illegible]													
LIGHT FIXTURES		[illegible]													

Fig. 2—Purchase and delivery chart

Purchase and Delivery Chart

The scheduling of the time required for the manufacture of the various finished products appears on the chart only as the distance between the "buy" and "delivery" dates. The actual record of these processes is kept separately on a secondary chart called the "Purchase and Delivery Chart" (Fig. 2). On this chart are entered the dates for ten steps which carry each sub-order through to delivery at the site. These dates are:

Order date; plans and specifications to manufacturer; full size details and template measurements to manufacturer; shop drawings returned for corrections; shop drawings approved; manufacturer's promise of delivery; final date of shipment; bill of lading received; superintendent's report of delivery.

Further details, such as the record of the various items of an order for bronze work, for instance, are kept in the form of a tickler card. This arrangement accomplishes two things: first, it keeps the tries and, by simplifying the entries of progress chart down to a minimum of enprogress, results in its being kept up and used; second, it allows for a much more detailed description of the minutiae of each subschedule than would be possible, were this information all to go on the central chart. A further advantage is the possibility thus afforded of dividing up the purchasing on all current operations between a number of executives, each of whom is responsible only for the buying for the jobs with which he is entrusted. The follow up of manufacturers and the entries on the "Purchase and Delivery Charts" are in charge of an expediting executive, who has this function only. This man receives carbons of all orders to sub-contractors, which serve as his cues for the entries on his charts, after which he takes the initiative and acts as a liaison officer between the purchasing department and the other departments of the organization as well as with the sub-contractors.

Checking Done by Home Office

In the case of our own concern, where each job is under supervision of one of our superintendents, the checking up for manufacturers is done by the home office, while the superintendents' regular reports indicate the amount of material received at the site at each date of writing and summarize each week the progress in each division of an operation. These reports are then checked against the job schedule in the home office.

This method, which has been developed for the insurance of prompt deliveries of materials, shortens the time required for the construction of a building, results in a consequent saving in the total cost of the owner, and gives him his building for use or for income-producing purposes at an earlier date than would be possible without some such form of scheduling and controlling the progress of construction.

Heating of Toronto Live Stock Arena

Mr. Malvern F. Thomas, consulting engineer, 229 College Street, Toronto, has been retained to prepare the specifications for the heating of the civic live stock arena and to supervise the execution of the contract. Tenders for the work are being advertised, the time for receiving the tenders expiring on Thursday August 10. Mr. Thomas reports that a complete and satisfactory heating system for the arena can be installed at an estimated cost of $104,623.20, using oil as fuel. The city architect estimates the cost of the building of the boiler house at $27,000.00, the combined estimated cost, therefore, being $131,623.00. The Board of Control of the city recently recommended that the city architect be authorized to proceed with the construction of the building of the boiler house by day labor, it being necessary that the boiler house should be completed in advance of the installation of the heating equipment.

Purging the Construction Industry

Living Up to a Standard of Responsibility—A Code of Honor in the Industry Whereby it Will be Built Up on Principles of Fairness and Justice

By JOHN B. LARNER
Washington Loan and Trust Co., Washington, D.C.

Before the American Construction Council

It is a signficant fact that world thought is concentrating more and more upon those things which make for the morality and fair-mindedness of the people. Invariably these questions arise:

In this or that proposition up to the standard? Does it measure up to your idea and mine of what is right? Does it give an impression at first sight of honesty or dishonesty? Or does it require close examination because of circumstances which arouse suspicion?

These questions are pertinent to the subject about which I will claim your attention for a few moments.

It must be admitted that there is a standard of morality. But, you say, what is that standard? Unfortunately, man is so constituted that he is prone to fix for himself a standard that may or may not be generally approved in business circles. Still, this does not mean that morals are so lax that men may juggle with them in such fashion as to enable them to place their own construction on right and wrong without regard for the standards generally approved by conscientious and thinking people.

I know of no profession or trade that demands a more strict adherence to the standards of morality than those professions and trades which have for their purpose the physical improvement of the world's surface. The building of homes, the construction of public or private improvements, require the services of men who are honest in their professions and trades. Contracts may be worthless paper to be destroped and disregarded to the detriment of those who supply the money, expecting and having a right to expect that the spirit of the contract will be carried out with honesty and sincerity.

Expensive Experience

I well remember when I was a young man, having my first experience in the matter of the construction of a house. I purchased the property before the house was completed. It was a part of the written contract that the house was to be completed according to certain plans and specifications, which were first exhibited to me and approved. I found after I had paid my money, and while the work was under construction, that the plans and specification had been lost, and the house was completed in a dishonest and unscrupulous way.

I was involved to such an extent that I had only two courses left me, namely, to bring all the parties into court for equitable relief or to take the property as it was constructed. Rather than be involved in litigation, almost always expensive and unsatisfactory at best, I took the property and suffered considerable financial loss.

We have reason to believe that in many instances contracts are disregarded and frauds perpetrated in the matter of building construction. The closest scrutiny of contracts, specifications and drawings is requisite in every case. The builder may defraud the owner or the owner may defraud the contractor. It would seem, therefore, that there should be some well regulated rule or standard that would serve to guide people in their business engagements.

I do not believe that any hard and fast rule can be devised which will fix a standard of morality. This would seem to be a matter of conscience, and, so far as I know, conscience, being a matter of the mind of the individual, cannot well be governed by fixed rules or regulations. Man's responsibility to his Maker, if recognized, is the only standard known to man whereby the conscience can be stimulated and controlled.

The Guilty Should Suffer

Some of our difficulties would be solved, and recourse to litigation in many cases would be avoided, if public opinion were strong enough to condemn improper practices in strong terms—so strong that the guilty man is shown up to the public gaze, renounced, and by law forbidden to continue longer in his profession or trade. It is, of course, doubtful if such a law could be made, and if made, there would be so many ways of evading its enforcement that it would be a dead letter.

The banker whose difficulties are many and exceedingly complex has to be constantly on the alert to prevent falling into the many financial pitfalls that are put in his way, in attractive form, by unscrupulous borrowers. He would welcome some standard of morality which would enable him to deal with his customers. But he waits in vain.

I do believe, however, that a standard of business ethics could be devised by those familiar with the subject which would go a long way toward solving the difficulty. The legal and medical professions have codes of ethics which contribute in no small degree in preventing malpractice and fraud.

There are certain standards now used by architects which are effective; and there may be other professions or trades which have codes of ethics. So far as I know these codes have not been standardized. They are separate and distinct one from the other and have nothing special in common for their enforcement. Certainly the rules of one organization are not binding upon any other organization and cannot be effective without concert of action.

Would it not be possible to so co-ordinate these rules or codes of ethics that they might work together and be effective as one common rule or standard for all such organizations?

Code of Construction Ethics

A method might be devised by the American Construction Council, acting with representatives from the several professions and trades, whereby a code of "construction ethics" might be formulated and adopted, which by reason of the power and influence of the council might prove effective. It is at least worth a trial. This plan may not be workable at this time, but something must be done, and that before long, to standardize the rules governing the professions and trades.

It is not right that any class of men should so conduct their business as to be able legally to impose upon their fellowmen by taking advantage of their needs and requirements. This is a great question and remains unsolved. We hope that the time is not far distant when all men will recognize the rights of their brethern, be content to deal honorably with them and be satisfied with a fair living wage or profit. If the moral standards are not recognized, we cannot hope to prosper either in a businee life or in our home life. Neither can we hope to see the world progress on satisfactory lines of economy unless man realizes that standards must be built upon principles of truth and justice. We must be true to ourselves and to our neighbor.

The collapse of the Knickerbocker Theatre in Washington last January was the direct result of the lack of true professional ethics. One has no right to build unless he conforms to the true ethics of his business.

Build a Standard of Responsibility

I cannot impress too strongly upon you business men, from the viewpoint of a citizen interested in all you may do in this conference, the importance of devoting time and thought to this great subject of moral standards. It is, I believe, essential that before you clean up the impurities of the "construction world" you reach the morals of the constructors; and then and then only you may hope for a speedy solution of your problems. There must be a standard of responsibility, and this applies not only to the constructors but as well to those who employ them.

I believe that better days are coming for labor and capital. There seems to be a turn in the tide. Men are now searching for real causes. Better understanding is near at hand. Selfishness must stand aside and the common good be given first consideration. The successful prosecution of the broad ideas and aims of this Council, conceived for the good of mankind, will solve many difficult problems and bring nearer the era of better understanding.

District Planning in the Essex Border Cities

Utilities Commission Responsible for a Comprehensive Town Planning Scheme

By an amendment to the Essex Border Utilities Act in 1920, the Commission was vested with the powers of the several town planning commissions which the city of Windsor, the towns of Walkerville, Sandwich, Ford and Ojibway were authorized to appoint under the Planning and Development Act. Viewed in its broadest light, this function properly exercised and with the support of interested external bodies should develop into one of the most important, far reaching and money-saving offices which the Commission has been called upon to perform.

Within the past few years, the Border Municipalities have been the mecca for the realtor who foresaw possibilities based on the unquestioned immediate development of some areas or the sometime growth of other sections contingent on industrial expansion. The growth along the Border has been phenomenal, its percentage increase being equalled in the past decade by only one city in Canada, that too being industrial in character.

Where a subdivision is to be placed upon the market, the owner must first secure the approval of the municipality in which the subdivision is located. If in a suburban area it must have the approval of any town within three miles or of any city within a five mile radius or if within a town it must have the approval of any city within five miles of its boundaries. The majority of subdivided property has been within suburban areas and it is only natural that the incorporated municipalities were not greatly concerned nor would they give much attention to these properties other than that required by the Act unless there was the prospect that any particular section might soon be included within its corporate area.

Commission Must Approve Subdivisions

Subsequent to May 20, 1920, all subdivisions within the area known as the urban zone of the Border Municipalities were required to be submitted to the Commission for their consideration. A town planning committee was appointed and all plans were submitted to them for their consideration before being signed by officials of the Commisssion.

It was apparent that intelligent oversight could not be given to this work unless a complete and correct map of the entire Border District was available showing all streets, highways, and existing subdivided areas. The boundaries of the urban zone were also irregular, being circular in outline. The first step of the Commission was to have a map prepared, fixing arbitrary boundaries of such an area by straight lines but as nearly as possible to include the area as defined in the Planning and Development Act. This map was submitted to the Ontario Railway and Municipal Board and approved by them on January 20, 1921.

The Commission instructed its engineer on August 18, 1920, to prepare a set of maps which would form the basis for later district planning studies and which would enable the plans presented from time to time to be co-ordinated with areas previously divided until a definite district plan was presented. This work was proceeded with until January 21, 1921, when the available appropriation was expended. It was again undertaken by resolution of the Commission on August 15 and the work is now nearing completion.

Since July, 1920, 83 plans have been approved by the Commission. In about one-third of them, alterations have been requested and secured before they were officially approved. In some instances, plans were received which when rejected by the Commission were not returned by the owners, the property being sold by metes and bounds rather than by registration. This means of transferring property can offset to some degree any effort which may be made to regulate small areas in their relation to adjoining property.

The Commission has adopted a regulation providing for a minimum lot width of 35 feet from January 1, 1922. This is one of the first steps toward a correction of the abuse of subdivided areas in this district. It is hoped that Town planning legislation will be secured which will enable any municipality to deal with the many problems which arise in this very important phase of urban or suburban development.

The Contract Record's

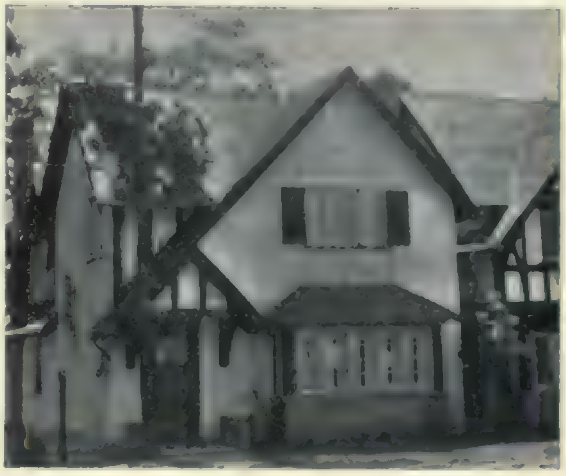
Weekly House Suggestion No. 29

Stucco and wood trim combine very attractively in the exterior appearance of the residence illustrated herewith, which was erected recently on Duart Park Ave., Toronto, by Mr. H. Addison Johnston. The wooden shingle roofing is stained brown to match the trim and the dark red brick around the front entrance and large bay window and in the chimney and foundations adds a pleasing touch of color to the general appearance. The stucco is on brick to the second floor and on metal lath above.

The large, bright living room at the front of the house is furnished with handsome brick fireplace with tile base. The hall is divided into two sections, the main staircase to the second floor being located in the front section and the cloak room and entrance to cellar stairway in the rear section. The kitchen, pantry and breakfast room, as seen on first floor plan reproduced herewith, are conveniently grouped at the rear. The breakfast alcove is a labor-saving feature that is being incorporated in many of the new homes, but not in all of them has it found so convenient a location as in this particular residence. There are two entrances at the rear, one on the pantry and the other on the rear verandah.

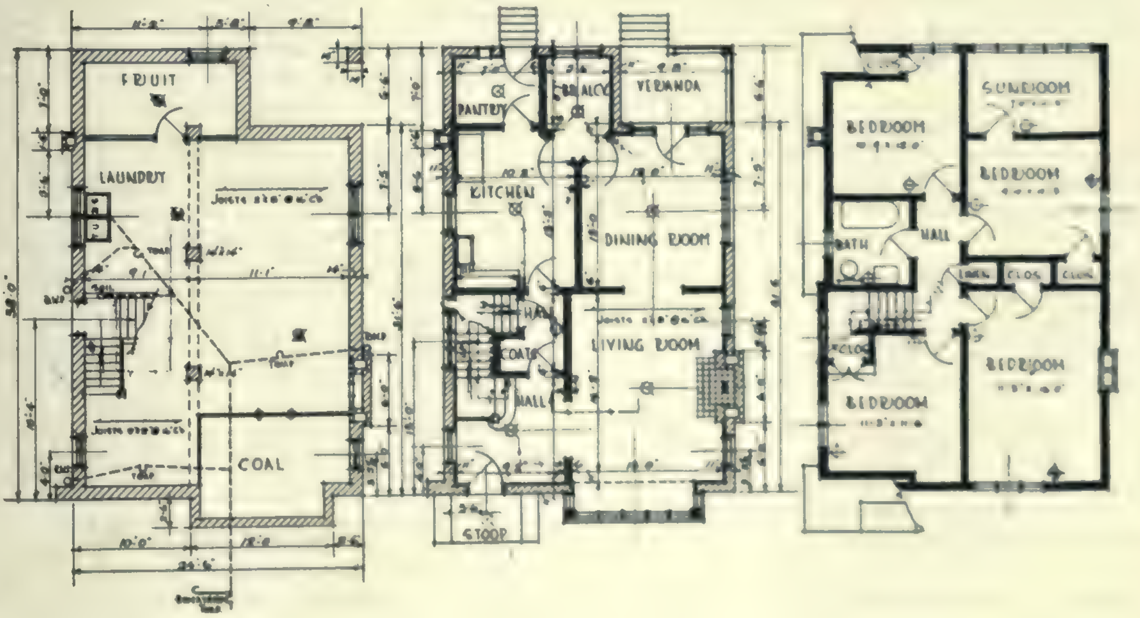
The trim throughout the house is gumwood, with the exception of the dining room and living room, which are trimmed in walnut and have beamed ceilings. The ceilings and walls to moulding in these two rooms and in the hallways are of rough stucco type. The second floor is finished in white enamel, with mahogany doors and solid brass hardware throughout, and the breakfast alcove on the first floor is also finished in white enamel. The flooring throughout the house is of oak.

There are four good sized bedrooms, a sunroom and bathroom on the second floor, every bedroom being conveniently located off the upper hall and each furnished with roomy closet.



Besides the large boiler room in the basement, there is space for coal storage, fruit storeroom and laundry. The heating system is of the hot water type.

Mr. H. Addison Johnston, 13 Silver Birch Ave., Toronto, designed this residence, which is located in the beautiful Beach District of the city.



New Brick Plant at Credit Forks, Ont.

The brick plant at the Credit Forks, Ont., recently purchased by J. H. McKnight of Toronto has been thoroughly overhauled and began operations this week. It will at present make both face and stock brick, but later there will be installed a plant for the manufacture of hollow block ware. The plant will be known as the Caledon Mountain Shale Products with head office at 88 St. David St., Toronto.

Mainly Constructional

East and West—From Coast to Coast

Milton Pressed Brick Co. Ltd., will move their Toronto office and show room from 48 Adelaide W., to the southwest corner of Adelaide and Bay Streets.

The master plumbers at Ottawa have signed an agreement with the men effective until April 30, 1924, the men accepting the offer of 80 cents an hour.

Alterations to the Canada Cement Company's mill at Lakefield, Ont., are at present under way, which, when completed, will practically double the capacity of the old mill.

A permit has been granted to Michael Tassef to erect a new movie theatre in Toronto, at 2789 Dundas St. West. The proposed structure will cost $130,000 and will be a three storey building, including several stores.

Traffic has been closed on the Gerrard St. bridge, Toronto, and the dismantling of the old bridge has commenced, to make way for the new $641,000 steel and concrete structure, which will take 16 months to construct.

October 9 this year will be fire prevention day in Canada. Citizens are asked to inspect their property and eliminate any fire hazards on that day. This inspection is to be applied also to factories, public buildings, warehouses, etc.

A recent report states that the machinery is being installed at McMurray, Alta., for the extraction of oil from the tar sands in this district. In a recent test, reads the report, two and half pints of lubricating oil were extracted from 25 lbs. of tar sands.

The government of British Columbia, this year is spending $99,000 on settlement roads, $198,606 on trunk roads serving settlements, $758,215 on main trunk roads and $250,000 on hard surfacing. Practically all work is to be done this year.

It is stated that the Canadian Johns-Manville Company are planning the erection of a huge plant for the manufacture of the finished product asbestos, at Asbestos, P. Q. The projected plant is estimated to cost over $1,000,000 and the report states that work is to be commenced very shortly.

There is a likelihood of the formation of a town-planning commission at Sault Ste. Marie, Ont. The proposal came up for discussion recently in council and was apparently favorably received, but no immediate action was decided upon, the matter being referred to a committee for further consideration.

The expenditure of $123,000 on civic improvements was ratified by the ratepayers recently at Halifax. This amount was made up by the following by-laws: $45,000 for the erection of a Nurses' Home at the city hospital; $30,000 for permanent sidewalks; $35,000 for water works extensions; $25,000 for sewer extensions, and $7,000 expenditure on parks in the city.

It looks as if Petrolea, Ont., will secure the big new plant of the Peninsula Sugar Co. Ltd. Tenders have been called for the blasting and grading of 1,400 yds. of railway trackage and the required railway ties, and it is expected that tenders for the construction of the plant itself will be called for shortly.

There are possibilities of a general strike in the very near future among the workers on sections 1 and 2 of the Welland Canal. It is claimed that the contractors on these two sections are not paying the schedule rate and demands have been made for increased wages, retroactive to May 1. Representatives of the workers have taken up the matter with Hon. James Murdock, minister of labor, at Ottawa.

The eleventh annual convention of the American Association of Port Authorities is to be held in Toronto, Ont., Sept. 14 to 16, 1922. The convention will be followed by an excursion from the St. Lawrence River to Montreal and then to Quebec, at both of which cities the port facilities will be inspected under the auspices of the local authorities. The secretary of the association is M. P. Fennell, Jr., of the port of Montreal.

An enthusiastic meeting was held recently at Sarnia, Ont., of about 100 good roads men, interested in the construction of a scenic highway from Windsor to Owen Sound, via Sarnia and Goderich. It is proposed to follow the shore of Lake St. Clair and River St. Clair, through Belle River, Stoney Point, Chatham, Wallaceburg, Port Lambton, Sombra, Courtright, Corunna, Sarnia, Kettle Point, Port Frank, Grand Bend, Goderich, Kincardine, Southampton and Owen Sound, the road to keep as close as possible to the shore of the various waters along the routes. The name Windsor-Goderich Blue Water Highway was decided upon and an association by this name was formed, with the following officers: President, J. M. MacAdams, Sarnia; first vice-president, J. O. Lundy, Windsor; second vice-president, W. W. Stover, Sombra; third vice-president, Mayor Wigle, Goderich; secretary, George P. France, Sarnia; treasurer, George Wands, Chatham. An advisory board and publicity committee was also elected, the latter under the chairmanship of William Gray, of Chatham, president of the Kent Motor Club. A resolution to the Minister of Highways was unanimously adopted asking for the designation of a highway along the above route.

Personal

Mr. R. W. Catto, architect, has opened an office at 47 King St. W., Toronto.

Mr. J. C. Gardner, city engineer of Niagara Falls, Ont., resigned recently from this position.

Mr. Frederick C. Clarke, of Toronto, has been appointed industrial commissioner of Niagara Falls, Ont.

Mr. John B. McRae, B.A.Sc., of Ottawa, has been appointed by the Hydro-electric Power Commission to investigate and report on the location of a joint gauging station and the regulation of the Trent waters to avoid any dispute as to the regulation and flow of water in the Trent system.

Trade Incorporations

R. B. Haley & Company, Ltd., with head office at Toronto, capital $150,000, to carry on the business of builders and to handle building supplies.

The Loxel Tile Company of Ontario, Ltd., with head office at Toronto, capital $60,000, to manufacture and deal in tile, brick and building materials.

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director

HEAD OFFICE - - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U.S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, August 9, 1922 No. 32

Speculative Activity Passing—Sounder Development Ahead

During July, construction contracts awarded in Canada, according to MacLean Building Reports, Limited, amounted to $26,694,200, compared with $35,620,400 in June and $17,741,400 in July, 1921. Residential building accounted for 35.3% of the July total, and amounted to $9,434,400. Business building amounted to $8,146,400, or 30.5% of the total; industrial building, $1,397,800 or 5.3%; public works and utilities, $7,715,600 or 28.9%. The value of contemplated new work reported during July was $30,970,600.

During June, the wholesale price index of 48 building materials advanced slightly, and is now 79.7% above 1913, compared with a peak of 183.8% reached in May, 1920. Prices have now declined 36.6% from the high. The recent slight upward trend in material costs is the result of a sudden demand for material and labor at a time when material stocks were low. It is interesting to note, however, that production is increasing and that a large proportion of the building material plants are working full time, and in many cases overtime, in order to meet the demand. It is not anticipated that increases will be great, in fact, the cost of building will, over a long period of years, decline gradually, with here and there a brief increase as the volume of activity becomes unusually large. This is a logical prediction and indicates that the average building project may now be undertaken without fear of a too great decrease in reproduction value with a consequent shrinkage of investment and mortgage loan collateral.

It is apparent that we have passed the crest of the first wave of building activity represented by speculative development. We are now entering the second and sounder period wherein better types of buildings will be constructed, and there will be much greater activity in architectural offices. Many large building projects which have been held up during past years are now being rapidly developed into the contract stage, and considerable activity is in prospect in the better types of housing and the provision of a great number of educational and institutional buildings, public buildings and business buildings. Now that general business conditions have become partly readjusted, good harvests should prove an active stimulant. If they turn out as well as now predicted, they ought to put a decided kick into fall trade.

"The Reign of Prosperity"

Apparently the war, and the boom, and the slump, and the very gradual recovery that has followed the misfortunes through which Canada has passed during the last ten years, have not yet worked a final and effective cure in some quarters. At a political meeting in Victoria recently, of which the occasion was the visit to the West coast of several of the Federal cabinet ministers, a prominent local member voiced the sentiment that the problem of settlement is the chief concern of the western province—that "immigration is necessary, and with it would come wealth, unemployment would be solved and prosperity reign."

Statements of this kind are harmful, because the half-truth contained in them tends to obscure the issue, which, at the moment, is the provision of certain and remunerative employment for the population already in the country. An immigration policy which would bring in a large number of settlers who might expect to earn a living in the building trades, would seriously aggravate the present unemployment problem, which slowly returning prosperity has not as yet solved by any means.

"The reign of prosperity" is a particularly misleading expression. Prosperity does not come of itself as this would imply, nor is it a permanent condition. It is, more than anything, a state of mind which, owing to the complexity and interdependence of modern life, is international in scope. Just as an indefinite "they" fix or change the fashions and styles in dress and manners, so an influence very difficult of definition or discovery by the average business man determines the changes of atmosphere in finance and general business which make the difference between times of depression and those of prosperity.

But this influence, which may be and usually is supposed to be centred at London or New York or Chicago or Montreal as the case may be, is itself governed by the changes in conditions at the distant centres of trade or work. It is a barometer, in short, of the composite mind and business feeling of those many centres where its own trading is done, and rises or falls in tone to adjust itself to the optimism or pessimism found in those outlying places.

Thus the circle is complete. Each outlying point contributes to the weight of evidence which causes the central barometer to rise or fall, and this in turn reacts causing times of depression or prosperity in business. An optimistic, forward tendency in any part of the world will therefore assist in the upward movement towards prosperity everywhere else.

But optimism alone is not enough, otherwise pronouncements of the kind here criticized would of themselves bring improvement. The great necessity is work, of a hard unremitting sort to which unfortunately many do not take kindly now-a-days. This, we are told, has also been the case in the west, where there has been a tendency to concentrate constructive activities on the provision of urban comforts rather than on definite productive enterprises. That this tendency is in the reconstruction period, changing to one of active encouragement to industries of a sort that utilize and develop the natural resources of the country is more solid ground of hope for a time of prosperity than a furtherance of the old habit of looking for some one from outside, be he immigrant or financier, to bring prosperity to us. It can never be too strongly emphasized, that a little of the self-dependence that made the early settlers of the country prosperous, in days when the population was very much smaller than it is to-day, will accomplish as much or more for us, their successors.

Help to Enact a Uniform Lien Law for Canada

The Association of Canadian Building and Construction Industries has been informed that one of the subjects which will come up for discussion at the coming meeting of the Commission for Uniformity of Laws in Canada is that of a standard mechanics' lien act for the Dominion. The meeting of the above commission will probably be held just prior to that of the Canadian Bar Association this month and the results will then be presented to the legislatures of the various provinces for action.

The question of mechanics' liens is one which is important to every one engaged in the building and construction industry. Differences of opinion exist regarding certain phases of the existing laws, as the result of the effect of their operation on supply-men, and on sub-contractors and general contractors.

The A.C.B.C.I. desires to be able to present a case to the Commission, and would like to obtain from contractors statements of their experience, and suggestions as to changes in the laws. Contractors are, therefore, asked to reply to the following questions:—

What changes do you suggest in your Lien Law? What improvements in its operation? Do you think the present law is adequate? What features do you think should be included in any uniform law for Canada?

International Roads Congress to Meet Next May

A certain indication that after eight years of war and upheaval the world is beginning to return to a normal state is contained in the announcement that the International Road Congress, which ceased operations in 1914 because of the European conflict, is to resume its deliberations early next May at Seville, Spain. The program for what promises to be the greatest and most important conference on highway improvement ever held has just been received from the office of the general secretary in Paris.

Thousands of delegates representing national and state governments and good roads associations in Canada, Great Britain, the United States, Belgium, Australia, New Zealand, China, Japan, France, Italy, Holland, Sweden, Denmark, Switzerland, Argentina, Czecho Slovakia, Spain, Portugal, Norway, Germany, Jugo Slavia, Poland, Austria, Cuba, Chili, Brazil and many other countries will participate in the congress and exchange views and experiences for mutual benefit. English, French and Spanish have been adopted as the official languages.

Canadian delegates will go to the meeting determined to bring the next congress to Canada. The first congress was held at Paris in 1908 the Second at Brussels in 1910, and the third at London in 1913.

Coal Shortage Threatens Building Industry

The effect of the coal shortage on industrial operations is being felt by the cement industry and the difficulty of obtaining coal has caused a number of U. S. plants to cease operations for the time being. A statement issued by the Portland Cement Association in Chicago points out that the cement industry is the fourth largest consumer of coal. Many of the mills have been having difficulty in securing coal for some time. With the regular source of supply shut off by the strike the mills have been forced to secure coal from more distant mines, at higher prices and a longer haul. As many of these sources are now cut off the situation has become acute and unless the strike adjusts itself in a few weeks, more of the plants will suffer.

Coming at a time when the country is experiencing one of the greatest building booms in its history, a shortage of cement would have a serious effect on every class of construction operation. As cement enters into practically every building that is erected the cutting off of the cement supply through the coal strike would tie up many of the building projects. A similar effect would be felt by the road construction industry, as cement is used in a large majority of highway programs.

Road Materials Drop in Price

Figures gathered in the United States show that average prices, January to May 1922, for road materials were 20 per cent lower than for the same period in 1921, and that the amount of materials used, as well as labor employed, increased 50 per cent.

Business is Brisk

Building activity in Ontario is gratifying, according to P. W. Gardiner, of P. W. Gardiner and Son, Limited, door and sash manufacturers, Galt, Ont.

"Buildings are going up everywhere in the province," states Mr. Gardiner. "Last year's business was good, but, if anything, this year's is better. Contractors and builders are busy and the trades derive corresponding benefit."

Club Houses with Special Features

Two Club Quarters in the Vicinity of Victoria, B.C., Substantially Constructed at a Moderate Cost—In One of Them Special Features of Architecture were Involved

Major K. B. Spurgin is architect and G. Calder contractor for the new club-house now approaching completion for the Uplands Golf Club at their new Cadboro Bay links near Victoria, B. C., the contract price of which is $5,400.00. Other items are plumbing $785.00 and drains with septic tank $260.00 making a total of $6,445.

For this moderate figure the club is obtaining a building of solid construction planned on modern and convenient lines, with ample accommodation for all purposes. The foundation is of concrete, and the building itself of frame construction, 2" x 6" studs being used for the walls. The building faces south, a verandah, 71' by 9' 9" on this side overlooking the green. French doors give access to the entrance hall from the verandah, the hall containing a large open fireplace and the staircase to the ladies' rooms above. There is also an enquiry wicket opening into the secretary's room. The hall, stairwell and upper hall are panelled to a height of 4' 6" with tapestry paper and wood rails. The upper part of walls and the ceilings are plaster finish.

Club-house for the Uplands Golf Club near Victoria, B. C.

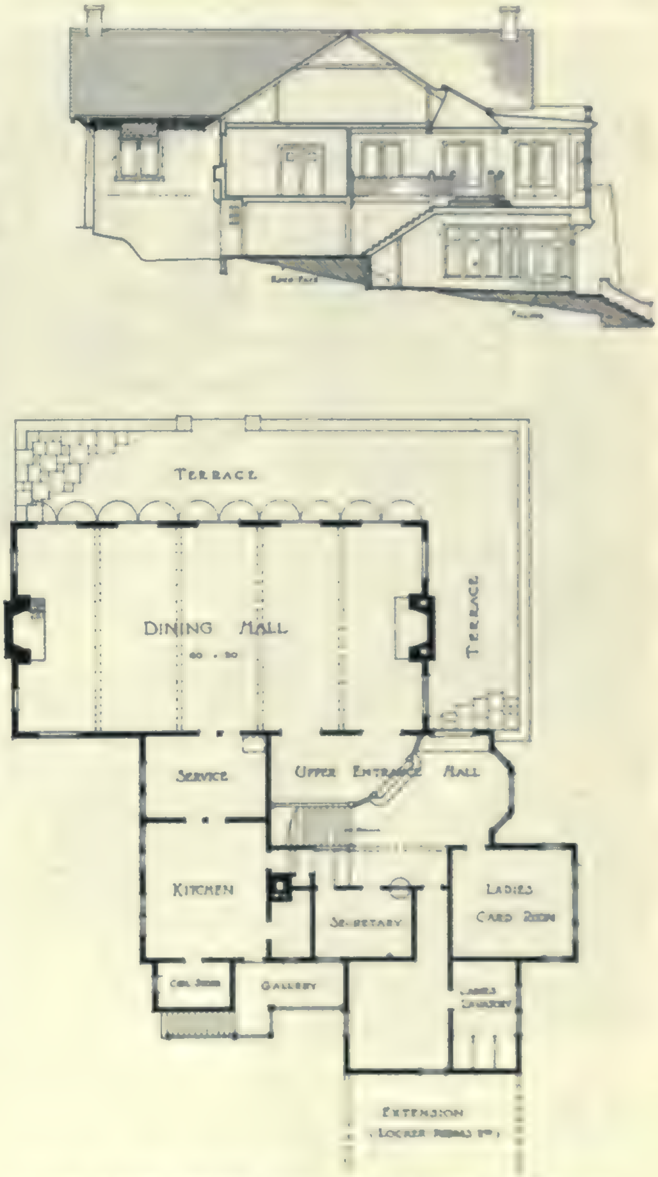
The secretary's room and professional's room are centrally placed and intercommunicating with each other and with the drying room and the men's locker room, which occupies a space of about 20' x 30' at the east end of the building. Lavatories are attached, fitted with toilets, urinals, wash-basins and showers.

The dining room, which occupies the entire west end of the building, and which is so placed as to overlook the 12th and 18th greens is a spacious room also 20' x 30' and contains a large open fire place with a four foot opening. Double acting doors lead to the kitchen, and to a large pantry, which are fitted with the usual conveniences, including sinks and drainers, range, cooler and a roomy back porch. A roomy balcony off the dining room on the north side overlooks the 1st tee and the 9th green, and connects with the dining room by French doors.

The upper floor contains ladies' rest room, locker room and dry room with lavatory attached. A feature of this floor is another large balcony, facing south, the dimensions being 9' 6" x 21'

Unique Features in the Colwood Club House

A second club-house, which is now nearing completion in the vicinity of Victoria, B. C., is that being built by Williams, Trerise and Williams, contractors, for the Colwood Golf and Country Club, for which P. Leonard James is architect. Some difficult problems have been met in the design of this building, which is of the rambling style of architecture peculiarly suitable to the country house and club building.



Plan and section through entrances of club-house for the Colwood Golf and Country Club, Victoria, B. C.

The site chosen for the building is the highest point of land on the course, and is an irregular elevation of solid rock. The result of this choice has been that entrance to the building may be had from three different levels, the architect having very ingeniously used this circumstance to add very materially to the picturesqueness and convenience of the building, both as to its exterior appearance and the arrangement of halls and staircases.

The main entrance is on the north side, and leads into a hall way underneath the service room shown on main floor plan. From this hall, steps lead down to the lower level, where are located men's card room, grill, lavatories, etc., and from which a second outer door leads directly to the course. There is also a staircase leading up from the entrance hall to the main floor, opening on the upper entrance hall, around which are grouped the secretary's room, ladies' rooms, services and dining hall.

The dining hall is the feature of the building, and is an immense room 60′ x 30′, with very large granite fireplaces at each end. The vaulted ceiling, with four very heavy framed trusses, add very materially to the effect. East and south of the dining hall is a terrace 12 feet in width, overlooking the course from an elevation of about 75 feet above the general level, thus giving an excellent view. French doors along the dining hall east wall give access between terrace and hall.

The dining hall is to be finished with walnut panelling to the springing line of trusses, with plaster above, which will give an exceedingly rich effect to the great room.

The outside finish is stucco throughout, with granite facings and half timbering in the gables.

The general contract includes plumbing and electric wiring; and totalled $17,800. A small amount of blasting was required in the preparation of the foundation, and this was done at a cost of $354.00 as a separate contract.

Plant of the British Columbia Cement Company at Bamberton, B. C.

Description of the Methods Adopted in the Manufacture of Portland Cement—Special Features and Equipment—Town Site and Conveniences for the Employees

By the Contract Record's Victoria, B. C., Correspondent.

The plant of the British Columbia Cement Company at Bamberton, B. C., has many points of interest, both as regards the product itself and the details of its manufacture, and as to the various items of machinery and plant generally which make it possible to turn out an exceptionally high quality product under somewhat difficult conditions.

The process is an adaptation of the English "White" process to the use of the raw materials available near the site, the location of which was selected with a view to convenient shipping facilities as well as from the standpoint of availability of materials. Limestone is found in a large vein on the site of the plant, and a quarry has been opened for its recovery at such an elevation that the materials has a down-hill movement throughout the preliminary grinding processes. The other principal ingredient, constituting the clay, or silica and alumina element, is obtained in the form of shale from a quarry at some distance, and is brought to the works on scows, from which it is lifted by a travelling crane into cars.

Quarry Operations

The quarry is very economically worked from a high face, which is kept at about the angle of repose of the loosened material. Drilling is done by compressed air drills, and holes are driven to a maximum depth of 20 feet before the shots are placed and fired. The result of such deep drilling is that while large quantities of rock are loosened at each shot, a good deal is in the form of large boulders, making a certain amount of "bull-dozing" necessary. After the limestone is reduced to sizes which can be handled by the crushers, it is lifted by a one yard Bucyrus electric shovel into narrow gauge cars which are then drawn up an incline by cable to an automatic tipping mechanism, where the rock is dropped into a hopper above the first crusher.

The maximum size of rock, after passing through these crushers, which are of the gyratory type, is about 1½″, with a considerable proportion of smaller sizes and dust. From this point it passes into the ball mills, after mixture with the correct proportion of crushed shale, which has meanwhile been passing through an independent set of crushers.

The grinding, from this point onwards, is by the wet process, salt water from the Inlet being used in the mills, and the material is reduced to a fine smooth mud known in the works as "slurry." This passes through screens designed to prevent the passage of any foreign particles which might become mixed with the mud during its passage through the grinding mills, and is finally pumped by a high pressure three-cylinder reciprocating pump to the slurry tanks up on the hill, where the material is kept in constant agitation by a stirring mechanism. Three of these tanks have been built, with a combined capacity of about 40,000 cubic feet. A continuous stream of slurry is fed to the kilns from the tanks by another set of pumps, in excess of the requirements, the overplus being returned to the tanks by a small flume.

Rotary Kilns

The rotary kilns, two in number, are at the highest level of the plant, and are said to be the largest of their kind in Canada. They are steel cylinders 10 feet in diameter and over 180 feet in length, and have a slight inclination from the rear or the flue end to the furnace end at the front. The slurry is introduced at the rear end, and is slowly passed through the kiln as it revolves, being gradually heated as it passes from the flue to the hot zone. The temperature at the flue is about 800 degrees and in the hot zone from 2,800 to 3,000 degrees Fahr.

This being the temperature of vitrification, the material is now clinkered, and drops out of the kiln at a white heat in particles in size from sand to that of an egg. The kiln firing is either fuel oil or powdered coal, facilities for the use of either being provided. A powerful jet of compressed air is used in either case, in combination with exhaust fans to ensure the necessary high temperature in the kiln.

From the kiln the clinker passes into a cooler, also a revolving cylinder, at the end of which is a screen which rejects any pieces which are too large to go through the tube mills below. Below the cooling cylinder is a storage bin in which the clinkers are accumulated and from which they art drawn for the final grinding process. This is carried out in tube mills, partly filled with an assortment of hardened steel balls or waterworn beach pebbles selected for their hardness and smooth surface. These grind down the cement clinker by impact, and after passing through a series of these mills the material is to all intents and purposes portland cement, having received the final admixture of the remaining ingredients by an ingenious automatic machine which measures the exact proportions required, after which, and a further thorough mixing, the now completed cement is carried along trough conveyors with a screw or worm propelling element, to the storage bins. These bins are in the form of cells and a total storage capacity is provided of about 15,000 tons, so that sufficient time can be allowed for the very necessary ageing process before the cement is withdrawn for sale. The stock of cement thus kept on hand will approximate in value $250,000, a fact which in itself gives an indication of the large amount of capital required for an enterprise of this kind.

Handling, Packing and Shipping

With the cement manufacture itself thus complete, the remainder of the plant is devoted to the handling, packing, and shipping processes, in all of which labor saving machinery of many sorts finds a place. As most of the cement sold is shipped in the familiar bags, principal attention has been devoted in this plant to providing efficient handling and transporting devices for the material packed in this manner, although a certain quantity is packed for foreign shipment in paper sacks or in paper-lined wooden barrels.

Making Cement at the Mill of the British Columbia Cement Co.

Upper left: the quarry. Upper centre: the wet mill where the raw materials are ground into slurry. Upper right: the automatic proportioning machines. Lower left: general view of the kilns, 10 ft. in diameter by 180 ft. long, fired by pulverized fuel. Lower right: the motor and gears driving the 180 ft. kilns.

From the row of filling spouts a continuous stream of the filled bags is carried along on belt conveyors and dropped into the ship's hold at the waterside, and a process is completed in which manual labor, as the actual handling of the raw material or of the cement is concerned, is practically non-existent. A considerable amount of labor is required nevertheless, and at the present time, with the plant running at about half capacity, there are about 50 skilled and as many unskilled laborers and mechanics employed about the works.

The question of specifications is an ever-present problem at any cement plant. There is always the ambition to raise the quality of the product on the part of the plant managers themselves and in addition to this, constant watch must be kept of the changing requirements of the various organizations entrusted with the preparation of standard specifications. And, for large buildings or works where a large quantity of cement will be required, it is not infrequently the case that some special requirements will be made that necessitate the preparation of what almost amounts to a special brand of cement.

It is this constant watchfulness and willingness to meet any reasonable requirements in the specifications of physical qualities, that has made portland cement the dependable material that it is to-day. And the watchfulness does not begin with the tests of finished cement with which engineers are more or less familiar; in fact, these tests are only the end of a long series of tests which follow the materials through every stage of the manufacture and check, hour by hour, the changes which must occur in any process which is using for its constituent materials stone or earth as taken from the natural strata, which are, of course, always likely to vary somewhat in quality.

At this plant, the managers are very proud of the fact that their product considerably exceeds in certain particulars the requirements of the ordinary specifications. As an instance, it may be noted that in the fineness test the product, which to meet the requirements should pass a screen of 40,000 meshes to the square inch to the extent of 78%, exceeds that minimum by nearly 10%, with a corresponding increase in strength.

Practically all the buildings of the plant have been built in reinforced concrete, and the same applies to the dock wall, which not only provided ship berths, but was the only means whereby a flat or level space could be provided for the shops and buildings at water level, as the side-hill on which the plant is built ran straight down into deep water. The dock wall is a composite structure of concrete piles and sheet piling, and although the conditions of the site would be trying to such a structure, gives ample evidence of solidity and sufficient strength.

Power for the many purposes of the manufacture and subsidiary operations is purchased in bulk from the British Columbia Electric Railway Company, and is brought into the plant at high tension. A sub-station, with transformers in a separate compartment and a very fine switchboard is fitted for the control and measurement of the incoming current and the distribution system, and on another floor of the same building watercooled air compressors driven by individual motors belt connected, supply compressed air for drilling in the quarry and for running of hoists and other various purposes.

In this connection, a somewhat unusual feature is incorporated in the inclined railway which is used for the transportation of men and tools to the various levels of the works. This railway is on a grade of about 35 degrees and the car is handled by a compressed air hoist and cable. The conformation of the ground is such, however, that at half-way up it is necessary to make a turn of about 45 degrees. This is accomplished by means of an ingenious turn-table arrangement, the car being locked to the table while the turn is being made. A second cable and hoist then make the balance of the trip to the top of the incline.

Powdered coal being used for firing in the rotary kilns, a coal grinder is a necessary adjunct to the plant, and unlikely as it may seem, the coal grinder house is almost the cleanest portion of the works. The plant consists of storage bins, grinder and dryer, and is housed in a building of reinforced concrete, which is perhaps remarkable for the fact that the cement used in its construction was obtained from beating returned cement sacks, and was found to be in excellent condition after storage for several years during the war when the plant was shut down.

Exhaust fans are used for drawing the powdered coal through the cylindrical dryer, which consists of two concentric shells through the inner of which fans draw the hot gases of combustion from a powdered coal burner. The space between the shells contains the coal to be dried, which is being continually passed through by suction and stored above for use as required.

A very well appointed machine shop is incorporated in the plant, capable of handling any repair work which may be required, as the plant is far removed from any commercial shop and must stand upon its own resources in this respect. About $100,000 is invested continuously in spare parts of various kinds for the grinding mills and other machinery, and a similar amount is tied up in loose tools for use in the plant and shops.

Being far from any city, the company has been obliged to provide living accommodation for its employees, and a well arranged little village, with all modern conveniences has accordingly been built. A school, hospital, post-office, and stores are included and within the limits of the plant itself are excellent quarters for unmarried men, for whom meals are also provided in a comfortable dining room.

Conditions at Bridgeburg, Ont.

Messrs. Somerville and Dilworth, general contractors, Welland, Ont., have obtained the contract for the proposed town hall at Bridgeburg, Ont., their figures being much lower than any others and amounting to $33,759. This does not include the cells for prisoners. Mr. Borter, Niagara Falls, is the architect. It is not intended that the hall shall contain a large room for public entertainments, but there will be a room large enough for holding court. The public library will be in the building, and accommodation will be provided for the town clerk and public officials.

Messrs. Somerville and Dilworth have been successful in Bridgeburg, having laid many sidewalks and having built the high school, to which they are now adding a fifty per cent addition, to be completed this fall.

Other building operations in town are few, and confined to residences. With the exception of the contemplated rebuilding of the International bridge which is to be double-tracked and supplied with carriage and footways, there is not much promise of building in general. However, it can be definitely accepted that the completion of the International bridge will cause a decided boom here in residential property, particularly along the boulevard to Niagara Falls. This is one of the most beautiful thoroughfares in Canada, and is likely to be bordered with a chain of palatial homes in the years to come. With substantial roadways on the International bridge, branch factories of Buffalo concerns may reasonably be expected to open here—some are here now, and they are prospering.

How Eliminate Waste in Building?

Practical Suggestions for Large Savings—Standardization as a Means of Preventing Waste—Free Estimates—Decreasing Lost Time and Unemployment

By D. KNICKERBACKER BOYD

Before American Construction Council.

Let us think of the enormous waste going on everywhere incidental to digging down for cellars and digging, refilling, and redigging and resurfacing of streets, roads and sidewalks for water and drainage pipes, conduits, sewers, and public utilities.

The necessity and opportunity for elimination of waste in this direction is great. I offer for consideration the suggestion, which is not new, that all newly developed areas, and all changes wherever possible in existing cities, shall have buildings started from grade, without excavations except for cuts to use as fills.

Indeed, with modern methods of heating, why should not the average house be built without a cellar, and storage for coal, provisions, etc., be afforded on the ground floor, eliminating waste of effort in going up and down cellar stairs continually.

Why should not streets in cities be built above the ground instead of cutting out the ground under them for every conceivable purpose and over and over again without regard for incidental losses and waste?

Having disposed of the ground (at enormous expense) we now come to construction of buildings. In this whole field, we of the construction industry are too apt to concentrate our thoughts on new work.

This is not right. We must differentiate between repairs and maintenance of existing structures, alterations and additions, demolition and reconstruction, and set it off against new work.

Fire and Loss of Life

Taking up existing structures first—two enormous wastes stand out.

These are preventable losses of property by fire, to say nothing of the more important loss of human life and man power, and preventable losses due to decay and deterioration.

To stop this waste of money and of thousands of lives and untold millions of man-hours due to fire alone, the surest means I know of is to make every one careful, and I suggest that we urge the adoption everywhere of personal liability laws to hold individuals responsible for the cost of extinguishing fires due to their neglect or carelessness. Let us also see to it that all possible fire precaution and protective measures are adopted in new construction work.

The other great waste which I have mentioned in connection with existing structures is the decay and deterioration which, through lack of knowledge and foresight and through downright carelessness, is allowed to go on everywhere when simple preventive measures involving construction materials and labor promptly and properly applied, would save countless millions of waste.

Here we have an opportunity to display our enlightened selfishness by selling the paint-up and fix-up idea to the public in its own interest as well as in the interest of the construction industry.

A vast amount of waste due to unnecessary individual effort could be eliminated if architects and engineers would, in co-operation with all industries, standardize the parts of certain buildings and standardize the detail drawings necessary to accomplish satisfactory results.

The participation of producers and manufacturers is vital in this program. Already the U. S. Department of Commerce has made a fine start in simplified practice, elimination of unnecessary types, sizes, patterns and finishes of many parts and articles related to construction. Its building code committee is also doing notable work in offering to the country a document which will assist in the economical and safe use of materials and produce further economies in the uniformity of dimensional requirements. The field of standardization is too large to more than touch upon here and of all the many possibilities I will mention only one.

Let us assume that, instead of each architect laboriously making detail drawings for window frames for all normal requirements, a universal box frame and sash were developed and adopted as standard and that this box was carefully and economically worked out to prevent air leakage. What would be the result? Cold would be kept out and heat kept in. Suppose the resultant saving in fuel, aside from the added comfort, was but one-half ton of coal to each home. What would be the elimination of waste on this one item alone?

I leave it to you to figure out, but it would not only amount to millions of tons and dollars, but reflect itself in relief to transportation and all down the line of construction activities.

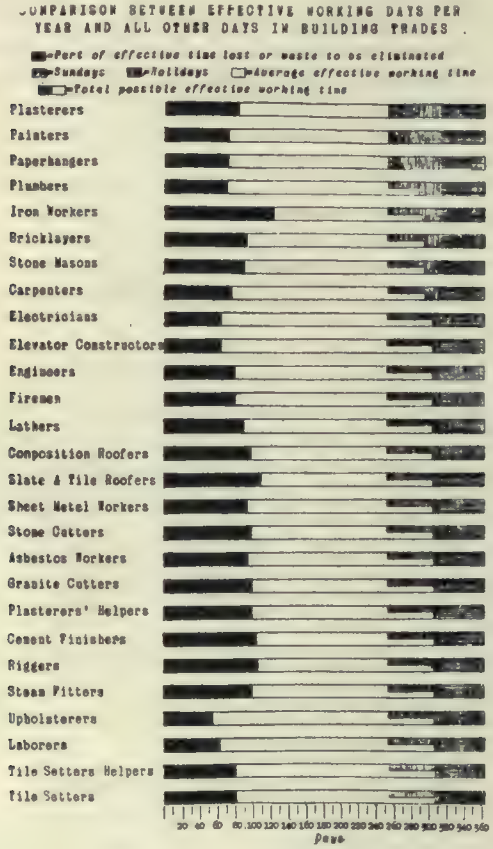
"Estimates Cheerfully Furnished"

The builder or general contractor next appears upon the scene and, by the use of three simple words in an innocent looking combination, he has had a very large part in causing waste. I refer to the slogan, "Estimates Cheerfully Furnished," which has so greatly contributed to the prevalent wasteful method of estimating on the drawings of architects and engineers. Specifications, too, must be standardized to intelligently say what they mean.

Some means should be devised to eliminate the enormous amount of time expended by builders and sub-contractors estimating on every building operation, many of which, as you know, do not proceed. That is an absolute loss. In my opinion builders should be paid a fee for estimating. That would be a benefit in several ways, one of which would be that owners would not require so many builders to estimate, and the builders would not require so many sub-contractors to estimate. Overhead would thus be cut down all along the line. The more experienced and capable builders would be given the preference. At the present time, when each builder or sub-contractor estimates, each one separately takes off the quantity. Another way to eliminate waste would be to have one quantity statement or survey, so all the contractors estimating would be figured upon the same quantity, and would merely appraise their units and their incidental expenses and attach their proper profits.

Complete Co-operation Necessary

We come next to the actual construction after having awarded a contract for a building, and there we find the greatest opportunity to eliminate waste. The only satisfactory method of proceeding in that direction is to have that complete co-operation between architects, builders, material men, all the subcontractors and all the workers on the job, which will come about through local effort co-ordinated with this A. C. C.



I want to give a very brief extract from an article in a recent issue of "Forbes" entitled, "Industry Can Double Productivity."

"Industrial efficiency in this country is no greater than 40 per cent., and probably as low as 15 per cent. of what it should be. A conservative estimate places it at 25 per cent. of fair and attainable standards. This means an industrial waste of 75 per cent. If we could eliminate preventable wastes, productivity would increase 300 per cent."

We have been making studies in Philadelphia of this whole question of the elimination of waste, but so far the task has been conducted by the workers themselves, strange as it may seem, and those workers are seeking the co-operation of the architects, engineers and builders, which is very gradually being secured.

"Sanford E. Thompson has said, "certain wastes stand out clearly in the building trades:

"1. Loss of working time throughout the year.

"2. Poor planning of construction work and of the individual jobs by the builder.

"3. Lack of knowledge of a day's work.

"We find that we must dovetail all these things together, so that every man shall have the opportunity to work; we must develop the technique of each industry, so that every man can make the best use of his powers; we must train the employer to plan his work and also to appreciate the human side of life.

"You may ask why studies of detail, why the determination of standards will aid in the elimination of waste. It is because it will increase the initiative of the worker, it is because it will differentiate the good man from the poor man, it is because it will present an aim to work to, because—and this is perhaps the most important feature of all—it will show us the easiest and most economical way of doing the work and will compel employers to take more thought to the methods of handling the work that is to be done. Thus costs can be and will be reduced."

A Congress or Conference Board

I want to add a brief sketch of what seems to me are the most pertinent and important problems to be solved in co-ordination of all facts connected with building. These can all be studied by each local group.

Such a group would act as a central bureau through which, voluntarily, all construction programs could be cleared, including national, state, municipal and private work in each territory. Suggestions could be made for co-ordination of activities, allocation of materials and reduction of estimating costs; local production could be encouraged, rail hauls shortened, traffic congestion lessened; a constant labor survey could be maintained and employment bureaus established to the advantage of the employer as well as of the employee; good management could be promoted, efficiency encouraged, apprentices educated and properly trained; and increased production would result all around.

Educate Public to Responsibility

In such a program another vital necessity is to educate the public to an understanding of the fundamental principles of a sensible distribution of demand for services throughout the year. Instead of carrying on our main construction work in seven or eight months that which could be deferred and done through the remaining four or five months should be so scheduled. Owners making interior alterations or additions to buildings should be encouraged to have this work done in the "off-peak" season. Old buildings should be demolished in the cold weather to make way for the new construction, and not (as is often the case) at the time when the new building itself might be under way.

Reduce Unemployment

I want to conclude by telling of some of the satisfactory work which is being undertaken in Philadelphia by the building trades. It pertains to the elimination of the greatest waste in the building industry, and that is unemployment. When it developed some time ago that no statistics were available or loss of man-hours in the building trades, Philadelphia set out to unearth all information possible. Through the secretary of all the unions and committees in the council, after months of investigation and final analysis with W. S. Hays, the figures arrived at by us have been charted. I think you will be surprised to find just what actually develops when for the first time, so far as I know, such an investigation has been put under way. This chart is, of course, somewhat tentative; it may be slightly inaccurate; but it represents the best results obtainable at present of investigations by men actually engaged in the building trades. We show you this chart, therefore, for the purpose of indicating the first step in determining the enormous waste that takes place. There are listed 27 of the building trades, the black representing the time in each year in each trade when no work is done. This chart is unique and I hope it will lead to remarkable results by indicating the desirability of similar studies being undertaken in all parts of the country to co-ordinate and develop the building industry. This and all such charts should be corroborated through concerted action with employers, and from now on a part of each union's duties should be to keep time records of all its men and give causes of unemployment for the use of each locality group.

Each trade must be carefully analyzed to find out where the loss exists and how to eliminate it. This is where the real work in co-ordinating building construction to eliminate waste begins. New work should be so co-ordinated with alterations and repairs by spreading them throughout the entire year as to keep up a steady demand for workers. For instance, when a branch of the American Construction Council is set up in Philadelphia, it is to be hoped that building owners and managers, such as those operating national and municipal buildings, industrial establishments, railroad stations and the like throughout the city, will schedule their requirements. The Director of Public Works and other officials, we hope, will immediately co-operate, will ascertain just what private work and other construction is proposed or scheduled, and will endeavor to plan the city requirements so that the peak seasons will not be crowded and overtime arise.

Studies of Separate Trades

Studies have been started in most of the Philadelphia trades and are now systematically under way to show what periods of the year are most crowded and hence liable to overtime demands and what periods are slack and in which more employment might be secured.

Suppose a survey were to be made of the structural requirements of the city of Philadelphia. The owners of department stores, of office buildings and of public buildings should endeavor to find out the loss of time during the off peaks in each of the trades, and arrange, if possible, to have the greater portion of their work done in those months when the men would otherwise be idle. The householders of the city could be instructed as to the desirability of having their paperhanging done in January, February or December, for instance, and might be encouraged to so order it. They doubtless would do so as a matter of public benefaction. If the trades were thus employed during the full year, it would not only eliminate waste but reduce costs. I dislike very much to talk about wages; but, if the men could be fully occupied throughout the year, their hourly wages could be reduced, and their annual earnings increased to the benefit of standards of living. The cost of building would fall in each branch of the trade throughout the entire structure, and throughout the entire year, in this locality and in all localities.

Masonry Canal Repaired by Cement Gun

Leaking and Dilapidated Power Canal, 1000 ft. Long, Restored by Applying Gunite Over Wire Reinforcement—Work Completed in Fifteen Days

Last year the Public Utilities Commission of the town of Napanee, Ontario, instructed their engineers Messrs. James, Proctor and Redfern, Toronto, to prepare a report and take tenders on repairing the headrace and canal which supplies the water to the town for developing the power to run the water works and furniture factory.

This canal, which is approximately 1,000 feet long, was constructed some thirty years ago of masonry. Its condition became such that the embankment was in danger and the leakage was causing trouble through a loss in head, and a contract was placed with the Gunite Co. of Canada Ltd., Hamilton, Ontario, to carry out the work by the use of the cement gun.

Specifications called for the walls to be built up to the original lines, the masonry to be cleaned by sand blast or wire brush; a reinforcement of 14 gauge wire to be anchored into place and a mixture of one part cement to three parts clean sand to be shot on to a thickness of two inches. This thickness of lining was carried up over the face and top of the walls and down the back for a distance of 12 inches, to form a seal.

The actual working time to complete this work was fifteen days with one cement gun and a twelve by ten portable Chicago pneumatic compressor.

Cement gun operator at work and reinforcement being placed

Section of completed work

Value of Back Plastered Construction

Cement Stucco on Metal Lath Without Sheathing Boards is Proved by Test to Have Excellent Qualities—Fire Resistant and Strong—Cheaper than Sheathed Construction

By JOSEPH LOSEKANN

In the "Architect and Engineer."

In the selection of the materials of construction most economical for dwellings, the majority of home builders have used the available materials in a manner established by custom, without regard to a better and more fire resistive construction in which these same materials may be used to greater advantage.

The principal qualities every home builder desires in his home and which in a great measure determine the choice of building materials are in most cases overlooked and a selection made in the hope of an economy ultimately destroyed by maintenance and repairs.

The conscientious architect has the following qualities in mind in building the home: beauty, durability, low up-keep, resistance to fire, low first cost, low heating cost. The materials or combination of materials fulfilling these qualifications should be considered regardless of following custom or obsolete practice and to the exclusion of all so-called economical materials.

There is no question that frame construction lends itself quite readily to the economical features of a building and to a considerable extent fulfills some of these qualifications. We have, however, the question of resistance to fire, up-keep and durability to consider which in a great part are overlooked in the selection of frame construction for the home.

We have available information as to the fire losses in dwelling construction. These enormous losses are due in great part to inadequate construction or the improper combination of available material. It is true that the major structural material is wood and wood will burn, but we can take steps to properly protect it from the flames and not condemn its use.

There is one material which lends itself more readily to building construction and that is cement stucco, but it has been abused and its improper use has caused a tendency to lean towards less fire resistive types of construction. Cement mortar or stucco is a material which in itself combines all the necessary qualifications as far as the skin coat of the building is concerned, and it is only necessary to determine the proper base or wall on which to apply the stucco to have solved all these conditions for the completed structure.

Causes of Blotches and Stains

The question has been asked so many times that if stucco presents all the necessary qualifications, why do we have so many cracked and blotched surfaces? It has been our experience that stucco itself is not at fault but the application and our not availing ourselves of the wealth of information presented by such bodies as the Underwriters' Association, Bureau of Standards, and eminent testing laboratories of research, which would keep us from continuing to make the errors in construction for which stucco is blamed.

It has been the practice in some localities to use sheathing boards over the studs, then a waterproofed paper, wood furring strips, a re-dipped galvanized wire or metal lath and the stucco. Upon examining some thirty or forty buildings constructed during a period of from one to five years we found that the surface of the stucco was cracked and in all cases where paint was not used, the surface presented a blotched and badly stained appearance. Most of these cracks appeared over the wood furring strips, some along the stud line and a great many near the water-table and the ground.

From this investigation we came to the conclusion that the introduction of wood in the stucco surface in the form of sheathing and furring strips cut down the thickness of the stucco coat over these strips and the alternate shrinking and swelling of the sheathing and wood strips caused the cracks. The blotched and stained appearance was made by the entrance of water through these cracks and at the ground by the capillary attraction of the stucco taking water from the surface of the ground.

To correct these faults, it is obvious that all wood should be eliminated from the stucco, that the stucco, be suitably waterproofed and that the surface be separated from the ground surface by a distinct break, either a course of brick or concrete. It was decided that although tile, solid concrete, stone or some other material of like nature was of greater value as a base for stucco than wood, their cost would be prohibitive and that if wood could be properly used, from its economical value alone, we would have gained much for dwelling construction.

The Value of Back Plastered Construction

Some twenty-five years ago it was thought necessary to nail wood sheathing on wood studs before the application of the reinforcing material and stucco. This custom has persisted in many locations but the back plastered form of construction has been found in the laboratory of practical experience to be more satisfactory in every respect. The tendency toward back plastered construction appeared first in New England and such satisfactory results were obtained that it was decided by the United States Bureau of Standards at Washington to investigate all types of stucco construction on studs with a view to giving authorative and unbiased information for the benefit of the public.

The series of tests was of a practical nature and followed a preliminary series begun in 1911. A two story building was erected, 200 ft. long, 26 ft. wide and 25 ft. high. The exterior walls were divided into panels approximately 10 ft. 2 in. high, each panel containing a window. Fifty-six panels were thus provided with various bases for plaster and various types of mixtures and methods of application. Of all the 56 panels No. 15 is the one which received a rating "Excellent" in all inspections by the U.S. Bureau of Standards, taken through a period of ten years. The construction of panel No. 15 is metal lath, attached directly to the studs with lath back plastered between the studs, stucco mixture being one part cement, one-tenth hydrated lime, three of sand (parts by weight.)

Quoting from the report on this panel, page 29.

United States Bureau of Standards Technologic Paper No. 70:

"Superficial inspection: Color — uniform dark grey; no cracks; surface rough; general appearance excellent. Detailed inspection; no cracks; bond good; condition—excellent."

In other words. back plastered metal lath without sheathing has the full 100 per cent rating, the same as monolithic concrete or brick.

The Underwriters' Laboratories, Inc., at Chicago, is the organization to which all insurance companies look for authoritative information on fire prevention matters. It is supported by the fire underwriting interests and is the recognized authority in that field. After a very exhaustive fire test on back plastered metal lath and Portland cement construction on wood studs, they have issued a report from which the following is quoted:

"This back plastered construction can be expected to provide sufficient heat insulation to prevent the ignition of the wooden supports to which it is attached for about one hour when exposed to fire of the degree of severity to which stucco finished buildings are likely to be subjected under average fire exposures."

The American Concrete Institute is composed of representatives of the United States Bureau of Standards, the Portland cement industry, concrete engineers, contractors, building officials, etc., who are anxious to standardize the use of Portland cement and find the best methods of construction with that material. Their committee on the "Treatment of Concrete Surfaces" is under the chairmanship of Mr. J. C. Pearson of the United States Bureau of Standards, is composed of manufacturers, contractors, an architect and an engineer insuring an unbiased and authoritative opinion. This committee has just recently rendered a report on a "Standard Recommeneded Practice for Portland Cement Stucco" in which they give the preference to the back plastered construction by virtue of its position in the report on "Back Plastered Construction on Frame Walls." and reference to the Underwriters' Laboratories' report and the United States Bureau of Standards' report above mentioned. They further state:

"The use of wood lath as a base for cement stucco finds many advocates and many opponents, but the committee does not feel it can recommend wood lath for cement stucco.

Strength of Back Plastered Construction

Recent tests made by Professor J. C. Peebles at the Armour Institute of Technology indicate that the back plastered stucco on metal lath for exterior walls is satisfactory from the standpoint of insulation and fuel saving. As noted above, the experience in the rugged New England climate shows that back plastered construction is entirely satisfactory.

In order to determine the strength of back plastered construction in resisting distortion, two distinct tests were but recently completed and serve to check fully, not only each other, but the findings of the United States Bureau of Standards, mentioned above. At the Armour Institute of Technology, Professor J. C. Peebles tested these samples, as follows:

Sample No. 1—Six inch, standard hollow building tile, laid in Portland cement, stuccoed with portland cement and plastered inside with gypsum plaster.

Sample 2—Portland cement stucco on 3.4 pound diamond mesh metal lath furred out over ⅞ in. sheathing, nailed to 2 x 4 studs. Inside plaster on 2.5 pound diamond mesh metal lath.

Sample 3—Back plastered construction using portland cement for exterior stucco and gypsum plaster on metal lath for interior wall.

The samples were standard construction by ordinary mechanics, sizes 42 x 42 inches, and were tested in an Olson machine with the direct pressure on opposite corners, simulating diagonal stresses due to wind, earthquake or settlement, and were under a steady pressure. The final crushing strength of the three samples was—hollow building tile. 9600 pounds; metal lath over wood sheathing, 10,000 pounds; back plastered metal lath construction, 14,200 pounds.

A test very similar to the one conducted at Armour Institute was recently completed at Omaha before the building committee of that city. These investigations again proved the great resistance of back plastered construction to distortion. Where wood sheathing, lath and cement stucco showed cracks at 2100 pounds pressure, the back plastered metal lath sample showed no cracks at 3500 pounds, the limit of the machine. Distortion at 2100 pounds for the back plastered construction was 3-16 inches whereas for the sheathed construction it was 1⅛ inches.

Metal lath as a base for cement stucco construction needs no introduction. Its usefulness as a fire retardant and its success as a stucco base has been established through a period of long service. Unfortunately prospective builders have looked upon it as costly and it has been placed in the class of fire resistive materials, desirable but too expensive for house construction.

In back plastered construction it is possible to use metal lath to advantage and without adding to the expense and at the same time accomplish all the desirable qualities of a permanent structure at no economical loss.

In this type of construction a metal lath stiff enough to span the stud spacing is used and the mortar is applied after nailing the lath to the face of the studs. After the first or scratch coat is applied, the metal lath is then back plastered between the studs and the additional mortar coats applied to the exterior which forms a solid cement sheathing properly reinforced. The stud framing used for this type of construction is similar to that used for other types except that braces between the studs are set back one inch from the face of the stud.

The cost of back plastered construction is cheaper than most types of wood sheathed construction, besides the added advantage of strength and durability which the wood sheathed type does not possess. It has been our experience that close to 10 per cent can be saved over the exterior cost by use of this type of construction.

Big Increase in Highway Contracts

Statistics compiled by Highway Information Service, New York, show that for the first five months of 1922 a sum of $35,258,000 more has been awarded for road and street construction in the United States than for the corresponding period in 1921. In May 1922, contracts let amounted to $9,626,000 more than the contracts let in May 1921. The figures show that notwithstanding a late start this year the program of constructing better highway is progressing more rapidly than ever and that this favorable condition will continue until fall. Contracts awarded for road and street construction in Canada show similar tendencies.

Driveways Through Tank Towers

If Elevated Tanks are Placed Over Roadways, Specially Designed Towers May be Necessary—Various Types that Provide Extra Clearance and How They are Designed

Elevated tanks for sprinkler and factory service are very often placed in crowded quarters, where space is valuable. In some cases, in order to find a location for it at all, the tower must be placed over an existing driveway or road. This adds somewhat to the cost of construction, as the tower details must deviate from standard practice, and if a great amount of clearance for trucks and wagons is desired, the columns must be made rather heavy, which increases the amount of steel work involved. The methods of providing driveway clearances, and the most economical types are outlined in the accompanying sketch.

If a single roadway only is required, a standard structure may sometimes be used. Sketch A shows, to scale, the tower for a fifty thousand gallon tank one hundred feet to bottom. A truck with an overall height of eight feet is placed under the diagonals and the sketch shows the amount of clearance provided. As there is always a possibility of a truck not keeping to the centre of the road, the diagonal rods are in some danger of becoming bent. Concrete curbs or boulders placed at the correct locations would serve to keep vehicles from getting too close to the side of the tower.

All driveway towers must have the riser pipes offset and brought down one of the corner columns, instead of placing the pipes at the exact centre of the tower, as is usually done.

In case the clearance provided by a standard structure is not sufficient, the rods may be arranged as in sketch B. This is called the "hogged rod" type, and is not much more expensive than the standard. The tower columns and other members remain the same.

If a clear height is desired, without any rods or diagonals in the clearance space, an arrangement such as shown at C may be used. As there are no diagonals in the bottom panel, the horizontal shear due to the wind load is taken up by the columns themselves. This requires that the columns be especially heavy to resist the bending moments. It is also essential that the column be in one piece from X to Z, as the point of maximum bending (if the shoes of the column are not considered as fixed), occurs at the point Y. The steel work details of type C are very similar to standard construction.

If an especially high clearance is desired, and side knee braces are allowed, the arrangement shown in sketch D may be used. In order to cut down the bending moment, the knee braces are brought down on the column as far as possible. As the tower details are special for this type of construction and the columns must be heavy, type D is more expensive to build than the others. The interior members of the lower panel all take compression and so must be designed at struts.

Design

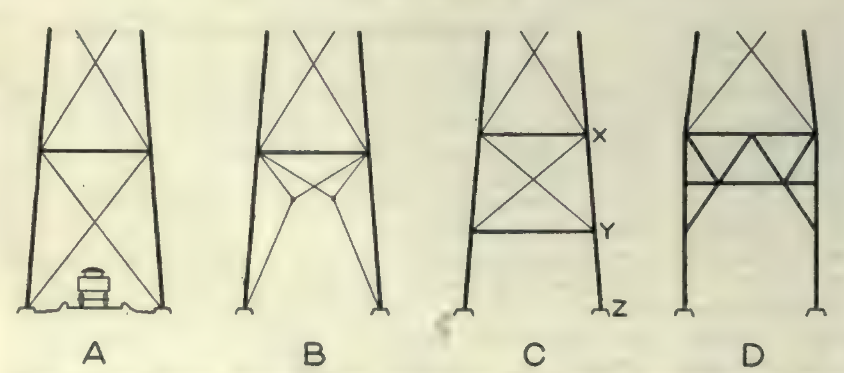
Tower B is designed in the same way as the standard tower except that the graphical wind stress diagram is somewhat more complicated. The rods in the lower panel usually have to be about 30 per cent heavier than in A.

In type C the tower may be designed in the usual way as far down as the point Y. The stresses caused by gravity loads on the columns of course, are unaffected by the absence of bracing in the lower panel. To obtain the direct wind stresses in the columns, take moments about one of the columns bases. In addition to the direct stresses there exists a bending moment in the columns due to horizontal wind loads on the tower. The reactions at the base caused by these wind loads are marked W in diagrams E and F.

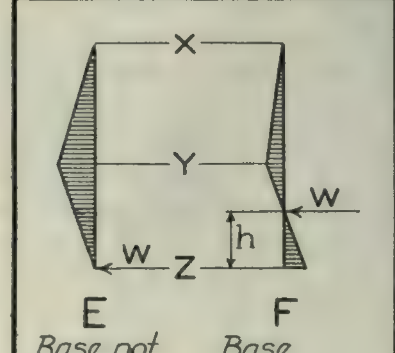
These diagrams, E and F, represent the bending moment diagrams for one column. If we consider the base as not being fixed, the maximum bending will occur at the point Y, and will be equal to W times the distance Y-Z. W is equal to the total horizontal wind load on the tower, divided by four, as we assume that each of the four columns takes its share of the shear.

If we consider the base as being fixed, the bending moment diagram will look like F.

The column is restrained by X and Y at the top and Z at the base. X and Y will deflect an equal distance horizontally as the wind load increases, and Z will remain fixed. Therefore, there will be a point of



Heavy lines denote compression members. Thin lines denote tension rods.



Base not fixed *Base fixed*

contraflexture, or inflexion, at some distance h above the base. This distance is usually about 6/10 of the distance Y—Z. The maximum bending moment in the column, then, occurs at Z and is equal to Wh. The bending moment at Y is approximately 2/3 of the moment at Z.

Whether or not the base is fixed depends on the detail of the column shoe. If the entire section is rigidly attached to the anchor bolt by means of the detail pieces it may probably be considered as being fixed. Practically, this is difficult to do. The actual condition may lie somewhere between E and F.

The direct loads and bending stresses in the columns having been found, a section with sufficient area and section modulus to accommodate them is selected. If the distance Y—Z is over ten or twelve feet, it will probably be necessary to use a section from fifty to one hundred per cent heavier than the panel above it, in order to take care of the bending stresses. Most specifications allow an increase of fifty per cent. in stresses due to wind combined with other loads.

A somewhat similar method is used in the design of tower D. The columns X—Z are considered independently of the tower, and the reactions of the columns on the tower are used for finding the stresses in the interior bracing of the first panel. It is really unnecessary to find the true stresses in the interior bracing as the section of the members, it will be found, is always determined by the maximum L/R which may be used.

If it is decided that a driveway under an elevated tank tower is necessary, the clearances required should be determined, and if possible either types A or B should be selected on account of the economy of the design.—From "The Water Tower" published by the Horton Steel Works Ltd., Bridgeburg, Ont.

Traffic Capacity and Highway Width

Design of Roadway Widths Must Give Consideration to the Speeds of the Various Classes of Traffic—Three Lane Highway Should be Discouraged as Dangerous to the Travelling Public

Committee report presented at the annual meeting of the National Highway Traffic Association.

There has been a large quantity of statistical data compiled throughout the country in the nature of traffic census and many traffic studies have been made to determine the future traffic for given highways. Most of such data is not of maximum value, however, in determining the desirable width of roadways for a given traffic, in as much as the variation in speeds of various classes of vehicles generally is not given consideration. Any computation of required width of roadway based upon the assumption that all the traffic on a given highway outside of a municipality will travel at a common speed should be used with great reserve, as the assumption is obviously incorrect in all but exceptional cases.

For the greater part, highways outside of municipalities need have but two lanes to care for the traffic which they are called upon to accommodate. Highways leading into large municipalities, or connecting nearby cities, however, present a problem that calls for careful solution in as much as they may, and often do, carry traffic that varies in speed from about 3 mi. per hour to 35 mi. per hour. In many cases, the quantity of traffic approaches, and often exceeds, the economical traffic capacity of a two lane roadway, although computations may show that the amount of traffic anticipated from traffic surveys could be carried adequately by a two lane roadway if the traffic is assumed to travel at a common uniform and properly selected speed.

Functions of a Highway

In cases of highways which are to carry congested traffic, the designing engineer must give careful consideration to all functions of a roadway which should affect his decision in choosing the number of lanes of traffic to be required and the modifications of widths of roadways and shoulders for any given number of lanes. The functions of a roadway which thus affect the design of its width are enumerated as follows:

1. To provide a sufficient number of lanes to carry the traffic that comes upon it.
2. To provide means of allowing fast moving vehicles to pass vehicles moving more slowly, the speeds being within legal and operating limits.
3. To provide for the ranking of vehicles at the roadside in such cases as for necessary temporary repairs.
4. To be of such a width as to discourage the taking of dangerous chances by operation of vehicles.

When a two lane roadway has become so congested that it is impossible to operate a vehicle without considerable loss of time due to traffic delay, its economic traffic capacity has been exceeded. This degree of congestion occurs for a traffic count of a great deal less than that equal to the computed traffic capacity of the roadway when variation in speed is not considered. As the amount of traffic or speed variations increase, the possibility of passing a slowly moving vehicle when it is overtaken becomes less. Ultimately, it becomes entirely impossible for vehicles to pass each other and all traffic must assume the speed of the slowest moving vehicle.

Relation Between Traffic and Width

To emphasize the relation that should exist between traffic and roadway widths, the results of office computations and field observations of traffic operation made by the chairman of the committee may be of interest.

For one typical series of investigations for a two lane roadway, a traffic of 750 vehicles per hour was assumed, 500 of which traveled in one direction, the remainder traveling in opposite direction. Three assumptions as to variation in speeds were made.

First: 3 per cent were assumed to travel at 3 mi per hour, 10 per cent. at 10 mi. per hour, 57 per cent. at 20 mi. per hour and 30 per cent. at 30 mi. per hour.

Second: 13 per cent. were assumed to travel at 10 mi. per hour, 57 per cent. at 20 mi. per hour and 30 per cent. at 30 mi. per hour.

Third: 13 per cent. were assumed to travel at 10 mi. per hour and 87 per cent. at 20 mi. per hour.

It was found under the first assumption that the meeting of two of the three-mile-per-hour vehicles slowed down traffic each way along the road for a distance of one-quarter mile. The meeting of vehicles of various faster speeds affected the movement of traffic similarly but to a less degree. It was also evident that 750 vehicles per hour, two-thirds of which are traveling in one direction and under the first outlined assumption as to variation in speeds, could not be operated on a two line roadway.

Under the second assumption of speeds, the meeting of two slow vehicles affected the traffic for a distance each way along the road of 300 ft., and the operation of the traffic under this assumption was entirely possible.

Under the third assumption, the traffic was shown to operate smoothly and the quantity could have been considerably increased.

The results of these computations were checked by observing the operation of traffic on roadways leading into Detroit, and the observed effect of varying speeds checked the calculations quite closely.

The foregoing results should be compared with computations based upon the assumption that all vehicles will travel at a common speed. Under logical assumptions as to clearance between vehicles, and assuming that all vehicles will travel 15 miles per hour, a two lane roadway should carry about 2,600 vehicles per hour in each direction. If the speed is reduced to 3 mi. per hour by a few heavy horse-drawn vehicles, the capacity is reduced to about 750 vehicles per hour in each direction. There can be no doubt, therefore, that the variation in speeds affects the traffic capacity and hence the required width of a roadway.

Shoulders Increase Capacity

Quite obviously, a stalled car which, through inadequacy of shoulder design, is prevented from pulling to one side and hence blocks one lane of traffic, has the same or a worse effect on the traffic capacity of a roadway than a slow moving vehicle. The roadway traffic capacity can be materially increased by adequate width and design of shoulders.

The safety of traffic should not be disregarded in the design of roadway widths. In the case of a two or four lane roadway, every vehicle operator realizes just when he has the right of way and when he has not. The operation of a three lane roadway, however, is not so simple. The centre lane is not and cannot be reserved for traffic in either direction, so it must be left to each individual operator to decide wether he is more entitled to this lane than another operator going in the opposite direction. Such a width of design fosters danger to traffic.

The following conclusions are therefore made:

1. The design of roadway widths must give consideration to the economically desirable variation in speeds of the various classes of traffic.

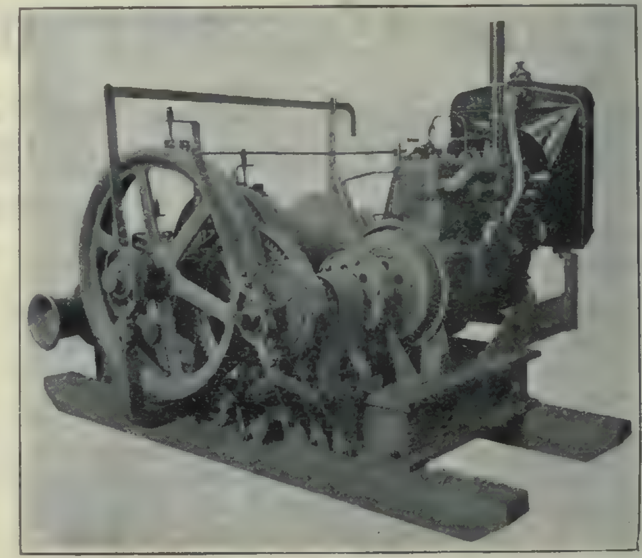
2. Any two lane roadway carrying intensive traffic should have a width of 20 ft. and should have 5 ft. shoulders capable of sustaining standing vehicles for temporary delays.

3. A two lane roadway should be increased to a four lane roadway when the traffic is reduced to the speed of the slower vehicles through not being able to pass, if the economic loss of time will justify the expense.

4. The building of three lane roadways should be discouraged due to the danger to the traveling public.

New P & H Elevator Hoist

To the contractors' hoist and derrick line built by the Pawling & Harnischfeger Co., of Milwaukee, Wis., U. S. A., has been added a gasoline-operated elevator hoist for double elevator work. The standard contractors' hoist may now be obtained, equipped with an elevator sheave in place of the nigger head on the back drum. Reversing is accomplished by means of friction clutches. An endless rope passes around the elevator sheave, then over guide sheaves and elevator head sheaves to the up and down elevators. The elevator sheave operates through a jaw clutch and works independent of the main drums. The main drums can be used for other purposes at any time. The hoist shown in the illustration is the 2- drum type J-50 equipped with a 5x6¼ Waukesha motor. The single line pull of this unit is 5,000 pounds; the hoist speed is 185 feet per minute, and elevator sheave speed 500 to 550 feet per minute with a rated load of 1,000 pounds.



Steel Cables as Girders

Interesting tests have been made of the great abundance of steel cables coming from the stores of the late German navy to determine whether the material could be used for other purposes. Inasmuch as cables made from high-grade steel are known to stand greater stresses than ingot bars, the possibility of wrapping these cables in concrete and using them as girders has been investigated in the first place. As pointed out by Professor O. Colberg at a recent meeting of the German Concrete Association, the cable girders thus obtained were tested as to their tensile and compression strengths, and the result obtained showed that the breaking strength and tensile stresses warranted the use of concrete cable-girders in the place of round iron girders.

Controlling the Quality of Cement

Problems Involved in Maintaining High Standards During Manufacture —The Relationship of the Various Operations and How They Are Controlled to Obtain a Quality Product

By RICHARD K. MEADE
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Before the Portland Cement Association

Contrary to the general belief, the question of the quality of cement is more often a mechanical than a chemical problem—or rather perhaps one of the relation of the mechanics of the process to the chemical composition of the product. The connection between the chemical composition of cement and its physical properties is now so well understood that there are few instances where the poor quality of the cement is due to a lack of knowledge of what the chemical composition of this should be. Generally speaking poor quality is due to circumstances which interfere with the attainment of the ideal composition by the chemist. In speaking of composition in this paper the term is not limited to the mere analysis of the cement, but includes the proper combination of the elements to form the so-called cement clinker.

The problem of manufacturing good clinker in laboratory quantities is extremely simple. It is merely necessary to grind finely a properly proportioned mixture of argillaceous and calcareous substances and then to ignite the mixture to the point of incipient vitrification for a sufficient time to allow proper chemical combination of the elements composing the mix. All the details of the process are well understood by cement chemists—the proper relation to be had between the argillaceous and calcareous elements, the fineness necessary to secure intimate contact and the degree of burning to promote combination are all matters of common knowledge in the industry. When it comes to handling large quantities of natural materials and to manufacturing cement economically, however, the problem is vastly complicated. To begin with the raw materials, these generally vary considerably in chemical composition in different parts of the deposit and the method of accurately sampling and proportioning these materials is one of the most troublesome problems with which the cement manufacturer has to contend. The question of the degree of grinding is generally limited by the mechanical equipment provided and is always influenced by the question of economy. The problem of burning is much simpler than the other two and is usually merely one of securing experienced and conscientious kiln attendants.

Relation of Operations

These three primary operations of cement manufacture bear a general relation to each other. Some years ago I called attention to the fact that, assuming the chemical composition to be correct, there is a very definite relation between the fineness of the materials, the temperature of burning and the time at which the materials are subjected to this temperature. I can possibly best illustrate this relation by means of a mathematical formula thus

$$F \times D \times T = C$$

In which F represents the fineness, D the temperature, T the time, and C clinker (a constant quantity). It will be seen that if C is a fixed quantity the others can vary among themselves and still equal C. Thus with a coarsely ground mixture the time or temperature of burning one or possibly both, must be increased to secure proper combination. Similarily if the time in the kiln is short this must be made up for by higher temperature or finer grinding.

If the fact that the composition of the mixture of argillaceous and calcareous substance can vary is considered, another variable is added to the equation. It is, of course, well known that it is much easier to burn low lime cement than high lime cement, in which case coarser grinding satisfies. In actual practice, the details of cement manufacture, therefore, are a general compromise to suit local conditions between chemical composition, fineness of grinding and degree of burning.

I am not going to take up time discussing the question of fine grinding of the raw materials or the degree of burning saying that fine grinding and harder burning as indicated above will tend to correct faulty composition in some instances. The importance of fine grinding of the raw materials and of proper burning are, of course, better understood and when these are the cause of poor quality the remedy is evident.

My own experience indicates that the problem of making cement of uniform high quality is largely one of absolute control of the chemical composition of the mixture fed to the kilns. Occasionally I have met with a plant where the raw grinding or burning equipment was insufficient, but for the most part the failure to control the chemical composition of the mix has been responsible for the irregular quality of the product.

Chemical analysis of the cement does not always show the trouble particularly when this analysis is confined to a sample representing a large quantity of cement, such as a bin of several thousand barrels or a day's run because such a bin of cement may be the average of several hours of very high limed and consequently unsound cement mixed with several hours of low limed cement; the average of the two being often near the desired chemical composition but the physical properties of the resulting cement pertaining something of the undesirable characteristics of both the high limed and low limed clinker.

Such a result is quite apt to occur in the dry process, where chemical control is generally a matter of examination of a mixture already made rather than of two materials about to be mixed. It is, of course, well known to most cement manufacturers that the routine tests of the dry mill laboratory are post mortems rather than diagnoses. They are of no value so far as correcting the composition of the particular lot of raw material under examination is concerned but serve as a guide to the making of succeeding lots.

Controlling the Mix

By far the larger number of mills, both wet and dry, make their mix by means of what are, in the vernacular of the industry, known as "readings." That is, samples of the mix are drawn from the grinding mills at stated intervals of time and in these samples the carbonate of lime is determined. If this is found to vary from the desired standard, no correction can as a rule be made in that portion of the mix which has already been prepared, and the test serves principally as a guide to the proportioning of succeedings lots, etc. When the mix is controlled by such a process, the chemist finding his mixture too high or too low in lime (as shown by the reading) decreases or increases his limestone to correct his proportions. In the dry process this often has the effect of sending his composition to the opposite extreme, with the result that while his low lime and high lime clinker will average properly very little of it is per se of correct composition.

In the wet process, however, an opportunity is generally given to mix the whole lot of ground material by combining the contents of several slurry basins in one large kiln feed basin and in this way the averaging is done before the kiln is reached and hence the clinker is of correct composition.

At many dry process cement plants, the question of chemical control is largely one of good judgment on the part of the chemist rather than of chemical test. For example, let us cite the case where a limestone and shale plant is supplied with rock by one large steam shovel. The shale is regular but the various strata of limestone differ much in chemical composition. Added to this variation is also the fact that 3 or 4 feet of clay overlying the limestone is not stripped from the latter but is blasted down with it. Deep well drills are used and the shots are large, each representing several months' supply of stone. All stone is sent direct from the shovel through crushers into a relatively small storage bin and the mix is controlled entirely by "readings" taken from the tube mill discharge. Let us suppose, as frequently happens, the shovel is working in the morning on clean limestone comparatively free from stripping. At noon, it encounters a limestone mixed with stripping and by night it has worked through the stripping and is back on the clean stone. What happens to the mix is this—sometime during the afternoon the sample drawn from the tube mill shows the mix to be overclayed and the chemist accordingly decreases the shale. The orders to make this change probably reach the raw mill about the time the shovel reaches clean stone again with the result that the next sample drawn from the tube mill will show the mix overlimed, etc. At this mill, the mix would generally be wrong but for the visual inspection and good judgment of the chemist. This condition is by no means unusual and while probably not existing often in quite such an exaggerated form, does occur in a more or less modified form at many mills.

Quarrying Methods

So far as quarrying methods are concerned, the steam shovel and the deep well drill are likely to stay, and it is also in most instances more economical to include the overburden in the blast rather than to strip; at the same time, it is evident, that these three improvements in quarry efficiency have increased materially in most instances the difficulty of securing a uniform mix. The big blast throws down the entire vertical face of the quarry in one jumbled heap. If it served also to mix the various beds intimately it would be of advantage, unfortunately the opposite is generally true and the beds remain almost as separate, but not as easily segregated, after the stone is blasted down as when in the position left by nature. In the case of the old method of quarrying by means of 16 to 20 foot benches, the beds were usually blasted down in some sort of order and could be quarried uniformly. The steam shovels also confine the stone supplied the mill to that obtainable from one or two points in the quarry, while with hand loading the stone can be obtained from almost the entire area of the quarry.

If the overburden could be intimately mixed with the stone there would generally be no objection to its being blasted down with the stone. Unfortunately this result can not often be obtained and the overburden usually lies over part of the rock only.

With these new conditions occurring in the quarry, provision must be made at the mill to take care of the irregular supply of stone and clay sent to the mill by the shovels. The influence of occasional variations in the composition of the raw materials are designed to be taken care of at most plants by storage bins of varying forms and sizes.

Usually the shale or clay supplied the mill, whether obtained by means of shovels or hand labor, is of regular composition. Sometimes with clay the moisture content needs careful supervision. A few mills use a calcareous shale in which the lime content varies over quite a range. The use of such shale always greatly complicates the problem of controlling the chemical composition of the mix by introducing two variables instead of one.

The employment of a large stone storage divided into two or more bins seems to be the most feasible method of securing a uniform raw material. In many instances, however, such stone houses are poorly designed. If we place rock continuously on the middle of a pile and draw at the same time below from the center of this, we will obtain pretty much the same stone that is being delivered to the pile and very little if any mixing will occur. Even where the discharge is not directly under the point of filling this flow of material between the two points occurs. In designing a stone house, therefore, this should be divided into at least two bins but I do not think anything is gained by numerous small tanks or bins.

Segregation of Materials

Another action which should be kept in mind is the so-called segregation of materials in the bins. If a mixture of coarsely crushed limestone is fed from an overhead source into the center of a pile it will be found that the coarse material will roll to the outside of the pile while the fine material will lie where it falls. If the pile is tapped from the center the first material drawn is almost entirely the fines while the coarse material is the last to be obtained. As the fine material usually contains the stripping and is always lower in lime than the coarse material, it will be seen that the composition of the material obtained when the pile is first tapped will be much lower in lime than that of the last portion obtained. Many plants employ what are termed blending bins, consisting of large tanks in which the coarsely crushed material is stored. My observation has been that these bins instead of blending actually segregate, for the reason given above.

It has always seemed to me that the travelling crane and grab bucket afford excellent methods of storing limestone. With this outfit the material as crushed can be uniformly distributed over a large pile. There is no segregation of fines and coarse and the reclaiming can also be distributed over a large area. It is a simple matter for the chemist to work out for the crane operator a cycle of filling and emptying such a storage which will give uniform material and leave nothing to the judgment of the operator.

Another excellent storage is one consisting of several long rectangular and fairly deep bins filled by means of an overhead belt conveyor. This latter is in turn equipped with a travelling tripper. This tripper is so designed as to move at a regular rate slowly back and forth over the entire length of the bin and spread the material in uniform layers over this. If the bin is relatively narrow and the openings below are alternately to each side of the center line, the segregation between coarse and fine material is negligible where the stone is drawn from several openings.

For those who prefer a pan conveyor or bucket carrier to the belt conveyor, the buckets can be arranged to deposit the material at a number of points in the bin. No doubt, other methods of securing the same result are available. Where a silo storage is employed, if the number of bins is sufficient to permit it, better results will be obtained by filling or emptying a number of these at the same time by some such method as I have suggested, rather than to fill and empty in rotation.

So much for the form of storage. Another fact which should be borne in mind, is that the finer the rock is crushed, the better mixture will be obtained and the less segregation will occur in the bins. For this reason, I would suggest crushing the materials as far as practicable before storage.

Determining Proportions of Mixed Materials

For determining the proportions of the two materials where the mixing is done directly after the large stone house, two methods are generally employed. One is to obtain a sample of the contents of the bins of clay and limestone and mix the two as indicated by the analysis of this sample. The other is what is generally designated as the "reading" method and consists in mixing the two materials according to the results obtained from a determination of the carbonate of lime in the mix after this has been ground in the mill. In spite of the fact that it is apparently much the less scientific of the two methods, the second one will usually give better results. This is because of the difficulty of properly sampling material in large pieces mixed with fines and intermediates.

The only method of sampling such material which will give accurate results will be some system of crushing and quartering in several steps such as is used for ore sampling and this would involve an expensive sampling plant. As an illustration of such a plant, let us suppose that the material came from the crusher in a pan conveyor. Arrangement could be made to trip every tenth bucket into a small crusher which would crush to say 1 inch and under. The discharge from this crusher would then be sampled and the sample crushed to say ¼ inch. This ¼ inch material in turn would be sampled and the sample crushed to 10 mesh. The fine material could then be sampled and this final sample ground to the necessary fineness for analysis. It will be seen that such an arrangement would involve handling quite a lot of material

In a cement plant using 1,000 tons of stone per day the first sample would amount to 100 tons to be crushed to 1 inch, the second to 10 tons to be crushed to ¼ inch, the third to 1 ton to be ground to 10 mesh and the fourth to 200 lbs. to be ground to laboratory fineness. It is doubtful if accurate results could be obtained with much greater fractions. It will readily be seen that the equipment necessary for such quantities is beyond that now available in cement mill laboratories.

The methods necessary for securing uniform rock at the mill are the same whether the wet or dry process is employed and to my mind the desirability of such a supply of rock of uniform composition is as great in the one process as the other. In the older wet process plants, provision was made for adding clay or marl as desired to the ground slurry before this was pumped to the kiln supply basins. To-day, however, when necessary to correct the composition of the slurry, the general practice is to mix two or more tanks to give the desired results, so that as far as the mix goes, the two processes approach each other much more nearly than they did when the raw materials of the wet process were marl and clay. In the matter of chemical control, there are unquestionably much better facilities provided at most wet process plants than there are in the general run of dry process mills. When difficulties of controlling the mix do occur in wet process plants, this is usually due to too few or too small slurry basins and kiln feed tanks or to improper or insufficient agitation.

Methods Insufficient

I have always felt that the methods employed to control the mix at most dry process plants were insufficient and that a system of correcting tanks planned after those of wet process plants could be employed to advantage. If the grinding is done in two stages, such as with ball and tube mills, I would suggest the use of two sets of tanks or bins. One set of at least four, and better, six or eight tanks to be placed after the preliminary mills (ball mills) and one set of four or more after the secondary mills (tube mills). The tanks in the first set should be sufficiently large to take care of at least four hours run of the mill. The system should be provided with an automatic sampler so that the contents of each tank can be sampled as ground. Where ample rock storage had been provided to give fairly uniform rock, the four tanks could then be used in this manner. One tank would be filling, the second tank would be under test and the third and fourth tanks would be used straight, or mixed if necessary to give the proper composition. When analysis proved a tank to be of incorrect composition it would be necessary to so proportion the next tank that the two could be mixed so as to give a mixture of correct composition. The second set of tanks would receive the fully ground material and these should also be provided with automatic samplers. They serve as a further means of correcting the mix when necessary by blending the contents of two or more tanks as the pulverized material is sent to the kiln. The mixing here is not as thorough as would occur when the two materials were ground, but still fairly good mixing would occur when screw conveyors were used to carry the mix from the tanks and considerable mixing would also be effected in the upper part of the kiln before the material began to form into balls.

At some plants, it would no doubt be found most convenient to use such a series of tanks for mixing. That is, to grind the materials separately to 10 to 20 mesh before the mixing is done. In this case certain tanks would be set aside for limestone and certain tanks for clay and both materials would be sampled automatically and mixed according to the analysis of these samples. It is comparatively easy to secure an accurate sample of 10 to 20 mesh material, while it is extremely difficult to obtain anything which will properly represent material crushed only to one inch. So that this system of sampling, analyzing and mixing will do with 10-mesh material but will not give satisfaction with one-inch material. The statement that the finer the material, the easier it is to sample accurately will hold good for all materials.

No doubt various modifications of this system would be devised to suit local conditions. For instance, at certain plants it might be found best to mix partly by analysis and then to do the correcting by adding to the contents of the tanks as drawn a small amount of clay or limestone ground to 10-mesh. I am not trying to outline a plan to be followed by all plants, but merely to indicate lines along which such a system may be worked out. The cost of operating such a system would be low and the initial investment small. I believe the saving in other lines aside from quality would pay for the installation and upkeep of the system. Such saving would include fuel required to burn over-limed mix, power to grind under-limed clinker, labor due to greater kiln outputs, greater life of kiln linings, etc.

In the earlier paragraphs of this paper, I have shown how the various steps in the process of cement manufacture bear one on the other. From this it will be evident that if there are shortcomings in one step these must be made up for in the next. If the composition is irregular, the grinding of the raw materials must be carried to the degree of fineness necessary to give sound cement from the high lime mixture as well as from the low lime. Every chemist knows that where the lime is high, much finer raw grinding is required than where it is low or even normal. In order to make sure of sound cement, the chemist must therefore grind finer where occasional runs of high lime material are encountered than where the mixture is constant. The proper fineness of the raw materials are therefore influenced to some extent by their composition.

Proper Burning of Cement

The proper burning of cement is largely one of feeding the material and fuel to the kiln at a regular rate. If the composition of the mixture is constant, it is evident that if the material is fed to the kiln at a regular rate and the kiln is kept at a definite temperature and revolved at a constant speed the resulting clinker will be uniformly burned. The trouble with the burning is, first, that the composition changes, requiring a higher temperature or a longer time in the kiln and, secondly, that the rate at which both raw material and coal are fed to the kiln is subject to violent and sudden fluctuations, or in other words, both coal and raw material "flood." I believe that where trouble with the burning results much of this can be eliminated by designing proper feeding arrangements for both raw material and fuel. The irregularities due to change of composition come gradually and can be kept up with, while the feeding of the raw material is usually sudden and the extra load of material occasioned thereby is hard to catch and properly burn. The arrangements for feeding slurry to the kiln, where this is done by positive means such as buckets and scoops, are excellent and something of the same sort is desirable in the dry process.

The qualities most desirable in cement are soundness, strength and uniformity in the rate of setting and hardening. All are dependent to a marked degree on chemical composition the fineness of the raw materials and the burning. These three steps are therefore the ones which must be under perfect control if quality cement is to be produced. I regard the chemical composition as the keystone of the arch. Unfortunately, it is the step least under control. While there are many plants where unsound or quick setting cement is a rarity, even here there might be an appreciable improvement in quality by a closer regulation of chemical composition. Most cement chemists are playing safe, as it were, rather than attempting to attain any ideals. Perfect control of the composition would enable them to make cements much higher in lime than they do at present, with the result that their clinker would be easier ground and the resulting cement stronger and more uniform in setting and hardening qualities.

Road Building Boom in Canada

Reports from the various Canadian provinces for June 1922 show contracts for new roads and streets let during that month to the value of $3,774,200. The total number of contracts let was 72. New projects reported under consideration numbered 146 and were to cost $4,697,600. The value of the new construction contracted for during June in each province was as follows: Ontario, $1,664,900; Quebec, $822,000; New Brunswick, $151,900; Nova Scotia, $115,000; British Columbia, $383,300; Alberta, $16,500; Saskatchewan, $26,000 Manitoba, $47,400.

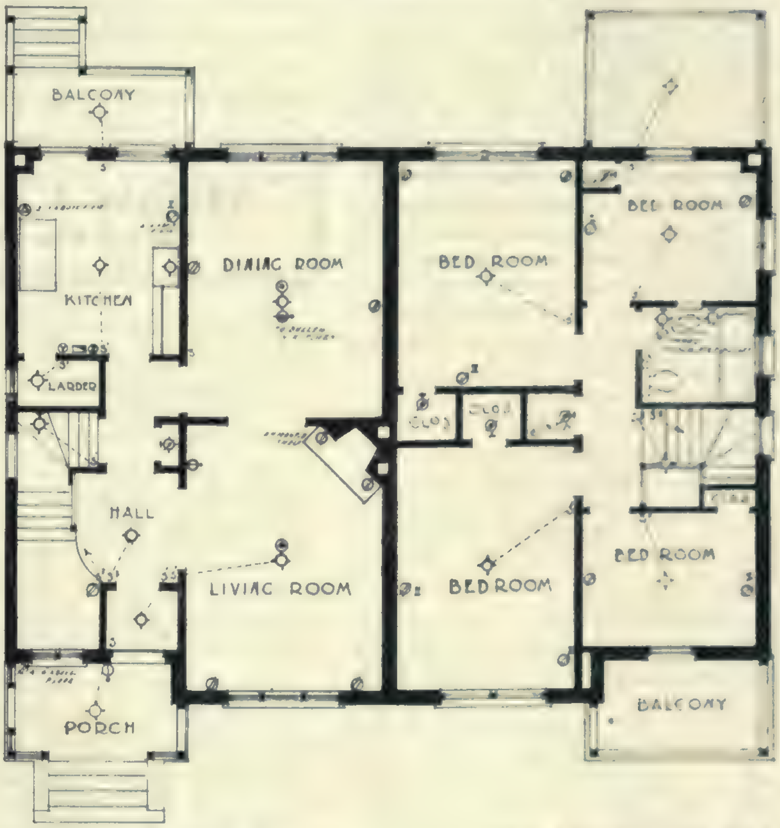
Celite Products Limited

The Celite Products, Limited, has been established in Canada to market Sil-O-Cel and Filter-Cel as manufactured by the Celite Company of the United States. Sil-O-Cel is widely used for the prevention of excessive heat losses from boilers, furnaces, etc., claiming a very high efficiency, high temperature insulation, and being furnished in brick, block, powder and cement forms. Filter-Cel is used as an aid in difficult filtering operations. Stocks of these materials will be maintained in Montreal. Mr. Lawrence Russel, former manager of the Armstrong Whitworth Company of Canada has been appointed manager of this company in Canada, with offices in the New Birks Bldg.

The question of most vital interest is whether or not the period of greatest stress is behind us. A decreasing total of failures in the United States during the successive months of the present year would seem to indicate a definite improvement in conditions. Canadian figures disclose a similar situation, in spite of the extremely high business mortality rate during the first half of the year. The record of solvency during the second quarter is an improvement over that of the first quarter.—Royal Bank of Canada.

The Contract Record's

Weekly House Suggestion No. 30



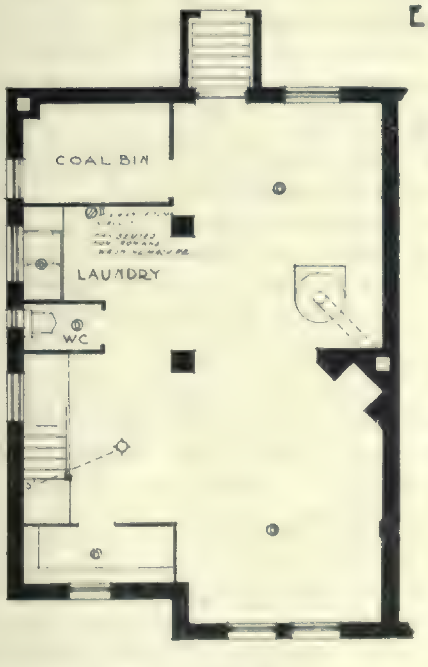
GROUND FLOOR PLAN **FIRST FLOOR PLAN**

ELECTRICAL SYMBOLS

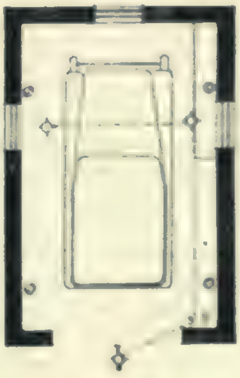
- ⌖ CEILING FIXTURE
- ⊙ DROP CORD
- ⌖ WALL FIXTURE
- ⌖ WALL PULL CHAIN LAMP SOCKET
- ◉ FLOOR PLUG
- ⊕ BELL TRANSF OUTLET
- ● ELECTRIC RANGE OUTLET
- ⌀ BASE PLUG RECEPTACLE
- II DUPLEX RECEPTACLE
- S WALL SWITCH SP
- S^3 - - 3WAY

LOW TENSION

- ▬ ANNUNCIATOR
- ⊖ WALL PUSH
- ⊖ FLOOR PUSH
- ● BUZZER



BASEMENT PLAN



GARAGE

Plan of moderate priced semi-detached house, a number of which are being erected at the present time in Montreal, P.Q. Montreal house builders report that they find these houses much more saleable when they are properly wired so that ample illumination and decorative lighting is easily available, as well as the necessary convenience outlets for the use of standard lamps and all electrical appliances so generally in demand in the modern home. The Montreal builders figure that the cost of wiring a home properly should amount to about five per cent of the total cost of the home.

Park System for the Windsor District

A Metropolitan Scheme for the Essex Border Municipalities—Utilities Commission has Jurisdiction over Park Problems Affecting the Towns as a Whole

The Board of Park Management of the city of Windsor wrote the Essex Border Utilities Commission on September 9, 1919 asking that it apply to the provincial legislature to amend the Essex Border Utilities Commission Act to provide for a Metropolitan Park Board. On October 1 a communication was sent to the Commission from the Board of Park Management of the town of Walkerville endorsing the action of the Windsor Park Board. At a meeting of the Commission on November 2 the solicitor was instructed to make such application at its next session to the Ontario Legislature to amend the Essex Border Utilities Act to grant the Commission the powers to act as a park board within the Public Parks Act and to act as a town planning commission under the Planning and Development Act. The Act was amended in 1920 by a section providing that "the Commission shall have and is hereby vested with the powers of a Board of Park Management to acquire, develop, lay out, maintain, and improve a metropolitan park or park system for the Essex Border Municipalities under the Public Parks Act."

The intent of this amendment was to secure for the municipalities in the district the same advantages in respect to parks that had already been secured with regard to water and sewerage systems. Those advantages would come from the co-operation of the various municipalities which are separate only in a political sense, and which could thus acquire, develop and maintain their parks at a reduction on the aggregate cost and be certain that no park work would be undertaken without consideration of the needs of the district as a whole and of the needs of the future as well as of the present.

The Park Board of Windsor and Walkerville, after securing an option on a piece of property of 168 acres known as the Clapp farm in Sandwich East forwarded this option on May 11, 1920, to the Commission for action. A park committee was authorized on May 31, with power to bring in a report upon a park system and the acquisition of land therefor. On June 25 the Commission's engineer was authorized to prepare a report upon a proposed park system.

In conjunction with this Clapp property, the park committee recommended that the Commission consider the acquisition of the property known as the H. O. Fleming Estate in the town of Sandwich. It was considered that the location of a park on the site would provide park facilities for the people of the western portion of the metropolitan district and would in addition permit the carrying out of a much needed improvement on the south side of Sandwich Street near London Street, eliminating a dangerous turn where the railway diverges from Sandwich Street.

On August 18, Morris Knowles, presented a verbal report on a comprehensive system of parks, boulevards and play grounds and discussed the advantages and disadvantages of the Clapp and Fleming properties which report was adopted on September 13, 1920.

The question of the acquisition of the Clapp and Fleming properties was submitted to the electors of all the Border Municipalities on October 23, 1920, but an unfavorable vote was received in Windsor and Ford City and no further action has been taken by the Commission.

Mainly Constructional

East and West—From Coast to Coast

The total value of building permits issued in Toronto, in July, amounted to over $3,750,000.

It is reported that a new bridge will be built in Walkerville, Ont., replacing the so-called Dromedary Bridge on Sandwich Street East.

The new B.C.E.R. steel bridge over the Vedder, near Yarrow, B. C., has been completed. Greenlees & Co., of Vancouver, are the contractors.

It is reported that Dodge Brothers, automobile manufacturers, Detroit, have purchased a factory site in Windsor and will erect a large plant there to care for their Canadian and possibly their export trade.

Mayor Reaume, of Ford, Ontario, recently announced that sewer extensions to cost in the neighborhood of $500,000 will be begun shortly, in view of the building of the new Ford plant. It is said that 150 new houses will be built to take care of the increase in population.

Replying to a largely signed petition urging the importance of improving Laurentian district, Hon. J. L. Perron, Provincial Minister of Roads, Quebec, said the work commenced by his department would be completed by November 1 and every bad spot in the route eliminated.

Ratepayers of the township of Teck, Ont., have voted to issue debentures for the construction of a water system for Kirkland Lake and Swastika, at an estimated cost of $40,000. The by-law carried in both places, and work is expected to start at an early date.

Any hopes which may have been entertained that Christ Church, North Yonge Street, Toronto, might be saved for use as a public library for North Toronto were shattered when the assessment commissioner announced to the board of control that the building had to be demolished, as it projected 16 feet over the street line.

The winding-up of the Red Arrow Tire Company, Peterborough, Ont., entered another phase recently with the examination of the claim of the contractors, Messrs. John E. Hayes & Sons. This action was mainly an investigation of the accounts presented by the contractors in their claim for approximately $50,000 against the company.

Appropriate arrangements are being made for celebrating the opening of the new highway entrance at Hamilton, Ont., on August 23. It is planned to have representatives of all municipalities interested in the work present when the official opening takes place. Members of the provincial government, as well as many others, will be invited to attend.

Union carpenters of Toronto, Ont., have rejected the decision on wages made by a board named to adjust wage differences between the union and contractors of the Builders' Exchange. The board, which was established by the consent of both parties, and not under the Industrial Disputes Act, fixed 82 1-2 cents an hour as the rate of wages.

With comparatively few boys starting in to learn the trade to provide for the future, there already exists a shortage of bricklayers in Toronto. Three hundred men could secure jobs at once if they were available, according to the Builders' Exchange and the Bricklayers' Union officials. One difficulty seems to be that skilled men, and not apprentices, are sought by the contractors.

Barnett-McQueen Co. elevator contractors, are completing work on a 60-tank addition to the plant of the Northwestern Elevator Company, at Fort William, Ont., in order to have it ready for the 1922 crop. The work on 40 tanks in addition to the storage plant on the Richardson elevator at Port Arthur is also being done by the same firm, the addition costing $1,500,000.

Alberta, the last province to take part in the national highway scheme, has just filed for approval plans for road improvement under the Canada Highways Act. All of the provinces are now working under the general regulations provided by the act, and the work throughout these provinces is now being carried out in accordance with the uniform standard specifications.

Rapidly increasing building activity in Woodstock, Ont., which from all indications, is likely to attain a record volume compared with recent years, is indicated by the report of permits issued during the month of July by the city treasurer, and by the sum total for the year to date. Forty permits were issued in the past month, amounting to $21,426, as compared with $7,258 for July last year. The total for the city so far this year is $177,202, as compared with $75,634.

Facts and figures regarding the Burrard Inlet Tunnel and Bridge Company were presented to a meeting of representatives of Vancouver, B. C., and surrounding municipalities by ex-Reeve Bridgman of North Vancouver district. He explained that a total of $115,000 had been paid into the company by various shareholders and of this amount about $1,500 was left, the remainder having been expended in securing engineering reports, legal expenses, preparations of plans, etc.

It is reported that it will be necessary early next year to replace a number of sewer lines in the down-town district of London, Ont., which were constructed several years ago at a cost of approximately $250,000. Numbers of cellars in the business section have been flooded this summer, and a survey to determine the cause and the remedy necessary is being made under direction of city engineer Brazier. It is said that the sewers are too small to carry off the storm water, and that large trunk lines on some streets will be needed.

Under the supervision of the Department of Public Works sixty bridges are now being built in Quebec and fifty have been completed. Among the first bridges to be opened is the East Angus bridge on the St. Francis River. It has cost over $200,000, and is a double-deck bridge. One of the decks has already been opened to traffic and the other will be finished on the 15th of August. After that date the lower deck will be reserved for the Brompton Pulp and Paper Company and the upper for the general public. Another bridge to be opened is at Lake Bouchette. In the district of Quebec the Leclercville bridge will be opened on the 13th of this month. The most important bridge, however, to be started shortly will be the Perrot Island Bridge on the Vaudreuil side.

The provincial cabinet of Quebec will be called upon in the course of the next few weeks to decide upon the construction of a $2,000,000 dam on Lake Kenogami, for the purpose of creating a reservoir. The Quebec Streams Commission has already been approached on the subject and the report is now before the Hon. Mr. Mercier, Minister of Lands and Forests, and it will be presented by him to his colleagues. Provisions have been made in a recent statute for the expenditure of $1,800,000 on this dam, but the matter was deferred for final decision until later on. The dam would give a permanent supply of 70,000 additional horsepower, 35 of which would affect the Chicoutimi River and the same quantity the Riviere aux Sables River. The present level of the water is 8 feet and it would rise to 33 as the result of this construction.

A large gathering of members of Local 2098, of the United Brotherhood of Carpenters and Joiners, who are mostly engaged in the repair and alterations of ships in Montreal, Que., unanimously endorsed the report of a board of arbitration which sat recently to consider differences as to wages which arose last April between the local and a number of navigation companies represented by the Shipping Federation of Canada, Inc. The scale of wages was fixed by the board at 55 cents per hour, day work, and 65 cents at night. This is five cents per hour above the rate which went into force April 22 last, but considerably under the scale asked by the men at that time.

The city council of New Westminster, B. C., recently let a contract for steel pipe for the proposed 24-inch pipe to the high level reservoir. The tender accepted was made by the Vancouver Engineering Works, Ltd., at a price of $30,976. It is for 8,400 feet of 24-inch steel pipe, with the bell and spigot type of joint, amended to suit the city engineer. Roughly, half of the pipe is quarter-inch and the remainder three-sixteenths, the thinner to be used on the higher levels where the pressure is less. Other prices submitted were: Vulcan Ironworks, $34,524, $31,104, $35,784, $35,364; Paterson Boiler Works, $37,312; Yarrows Ltd., $40,950, $34,500; Coughlans Ltd., $35,000. This diversity of price was consequent on a number of factors. Some offered dipped pipe and alternatively painted pipe. Various types of joint were offered, including bell and spigot, loose ring joints, electrically welded, rivetted, etc. Delivery was also a controlling factor.

Obituary

John Allan, ex-M.P.P., and ex-Mayor of Hamilton, died recently. He came to Hamilton in 1864. After travelling extensively in Western Canada, he went to New York in 1879, where he was engaged as a building contractor, and was very successful. In 1908 he was elected to the city council of Hamilton as an alderman, and after serving as chairman of the Board of Works, was elected a member of Hamilton's first Board of Control. Since 1920 he had been a member of the Parks Board.

The O. A. Cole Co., Ltd., have been awarded the contract for water-proofing all the buildings of the Canadian Kodak Co., at Mount Dennis; also for the hardening of the concrete floors, with Truscon Agatex, of the Firestone Rubber & Tire Company's building at Hamilton; Ont.

The Eleventh Annual Safety Congress of the National Safety Council will be held in the Cass Technical High School, Detroit, Aug 28th to Sept 1st.

CONSTRUCTIONAL ACTIVITY

Period of August 2 to August 8, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Blanshard Twp., Ont.
Plans will be prepared for tile drains for Twp. Council. J. H. Jameson, clerk, St. Marys, Ont.

London, Ont.
City Council plan construction of trunk sewer to cost $250,000 on King St. H. A. Brazier, Engr.

McKillop Twp., Ont.
Jno. McNay, Seaforth, clerk McKillop Twp. Council, has plans and will receive tenders until Aug. 21st for construction of tile drain.

Ottawa, Ont.
City Council plan construction of Tarvia pavement on Ernscliffe Rd. A. F. Macallum, Commr. of Works.

Port Dover, Ont.
Plans are drawn for sewerage system to cost $24,000 for Town. James, Proctor & Redfern Ltd., Engrs., 36 Toronto St., Toronto.

CONTRACTS AWARDED

Brockville, Ont.
Wm. Leacy, Prescott, has general contract for construction of sewers costing $10,000 for Brockville Council.

Edmonton, Alta.
General contract for construction of watermain costing $11,500 for City is awarded to C. L. Devall, 96th St.

Etobicoke Twp., Ont.
General contract for waterworks construction for Twp. Council is awarded to R. C. Huffman, 16 Glen Grove, Toronto. James, Proctor & Redfern Ltd., Engrs., 36 Toronto St., Toronto.

Kincardine, Ont.
Town Council awarded following contracts for slow sand filters and equipment: Tubes, National Iron Corp. Ltd., ft. Cherry St., Toronto; tubes, L. J. Looby, c/o F. W. Thorold Co. Ltd., Engrs., 54 Admiral Rd., Toronto; pumps, Goldie & McCulloch Co. Ltd., Galt; sewer pipe, Clay Products Agency Ltd., 9 Wellington St. E., Toronto; valves, T. McAvity & Sons Ltd., 95 King E., Toronto; sand washer, Jno. Inglis Co., 14 Shrachan Ave., Toronto; gasoline tanks, S. F. Bowser Co. Ltd., 66 Fraser St., Toronto.

Merritton, Ont.
General contract at $32,000 for concrete pavement on Main St. for Town is awarded to Reid & Somers, 40 Adelaide St. W., Toronto. F. N. Rutherford, Engr., St. Catharines.

Montreal, Que.
General contract for construction of sewers on Walkley Ave. and Lepailleur St. for City is awarded to C. Frascarelli & Co., 7171 Sherbrooke St. W.

Ottawa, Ont.
General contract for construction of pavement on Nicholas St. for City is awarded to O'Learys Ltd., Banque Nationale Bldg.

Railroads, Bridges and Wharves

Bentinck Twp., Ont.
Twp. Council plan rebuilding of several bridges. J. H. Chittick, clerk, Elmwood, Ont.

Cowichan Bay, B. C.
Construction of rly. at cost of $200,000 is contemplated by Cowichan Bay Rly. Co.

Hartland, N. B.
Construction of steel bridge is contemplated by Prov. Gov't. Mr. Hill, Chief Engr., Fredericton.

London, Ont.
London Street Rly. Co. contemplate paving to cost $18,000.

CONTRACTS AWARDED

Cardwell Parish, N. B.
Parker H. Currier, Grey St., Fredericton, has general contract for construction of concrete culvert for Prov. Gov't.

Dalhousie Parish, N. B.
General contract for construction of steel bridge for Prov. Gov't. is awarded to Byron F. Hall, Penobsquis.

Grandview, Man.
General contract for bridge for Municipality of Grandview is awarded to Poole Construction Co. Ltd., Hamilton St., Regina.

Toronto, Ont.
Additional contracts for addition to car barns costing $225,000 on Eglinton Ave. for Toronto Transportation Cmsn., are: Reinforced steel, Burlington Steel Co., 60 King W.; structural steel, Dominion Bridge Co. Ltd., Imperial Life Bldg.; plumbing, heating and sprinklers, Sheppard & Abbott, 119 Harbord St.

Wellesley Twp., Ont.
Twp. Council awarded contracts for concrete abutments and steel superstructure for bridge to A. Fraser, New Hamburg, and J. K. Hill, Mitchell, Ont.

Public Buildings, Churches and Schools

Birchcliffe, Ont.
Erection of addition to church is planned by St. Nicholas Anglican Church Congregation. Rev. W. G. Taylor, Birchcliffe.

Blairmore, Alta.
Min. Pub. Works, Prov. Gov't., will receive tenders until Aug. 15th for erection of barracks to cost $78,000. Plans with R. P. Blakey, architect, Parliament Bldgs., Edmonton, Alta.

Craigmyle, Alta.
Surprise S. D. No. 2142, Craigmyle, will erect a school. J. E. Blore, secy.

Fairville, N. B.
Erection of fire station at cost o $15,000 is contemplated by Town Council.

Hamilton, Ont.
Sunday School costing $10,000 is being erected by St. Davids Presbyterian Church Congregation. McPhie & Kelly, architects, Bank of Hamilton Bldg.

Erection of church is planned by St. Anns R. C. Church. J. W. Englhert, 120 Sherman Ave. N.

Hartland, N. B.
Plans are being prepared for school to cost $25,000 for School Bd. W. D. McPherson, architect.

London, Ont.
Jno. M. Moore, architect, 489 Richmond St., has plans and will receive tenders until Aug. 17th for erection of Natural Science Bldg. to cost $250,000 for Western University.

Tenders will be called shortly for erection of Arts Bldg. to cost $200,000 for Western University. Jno. M. Moore, architect, 489 Richmond St.

Plans will be prepared for central heating plant to cost $25,000 for Western University. Jno. M. Moore, architect, 489 Richmond St.

Milverton, Ont.
Erection of addition to school is contemplated by Milverton School Bd. W. J. Spencer, secy.

Montreal, Que.
A. H. Lapierre, 30 St. James St., Montreal, and Stevens & Lee, 62 Charles St. E., Toronto, architects, have plans and will receive tenders until Aug. 15th for electrical, plumbing, heating and ventilating system required for hospital for Notre Dame Hospital, 351 Notre Dame E., Montreal. Accepted cheque for 2% of tender required.

Erection of hospital is contemplated. Interested, Dr. Geo. Dupont and E. M. Stearns, 218 Sherbrooke St. W.

Oshawa, Ont.
Hutton & Souter, architects, Bank of Hamilton Bldg., Hamilton, have plans and will receive tenders until Aug. 12th for erection of school for Oshawa Bd. of Education. Plans also with Bd.

St. Alexis de Grande Baie, Que.
Erection of school is contemplated by School Bd. Frs. Bergeron, secy.

St. Apollinaire, Que.
Erection ofschool is contemplated by School Bd. E. Rousseau, secy.

St. Faustin Station, Que.
Plans are being prepared for school

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director

HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U.S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, August 16, 1922 No. 33

Do You Ever Speak to Them?

"Is there a new house being built in your neighborhood? As you are leaving home for your office do you meet some of the brick masons, or the carpenters, or other men working on this home? Do you pass them by without a sign of interest in them? Or do you give them a cheery, Good Morning? Do you recognize them as the builders of your neighborhood? Do you occasionally stop one of them and say, 'That's a beautiful house you fellows are putting up'—or, 'You fellows got those foundations in in quick order, didn't you?'—or, 'My wife tells me she never saw a neater looking lot of workmen than you fellows'—or, 'We are glad to have you men working in our neighborhood; don't you think we've got a pretty village?'

"Workmen like to serve in a good cause. They take pride in doing something worth while. They enjoy working where people show a little appreciation for and fellowship with them. If you can't do anything more, you surely can say, Good Morning! to the fellows whom you are meeting morning after morning. You have your work and they have theirs —and both must be well done and in a spirit of fellowship— if the world is to be peaceful and happy."

The above quotation is from a recent issue of the "Rotarian" and presents co-operation from a somewhat different angle. Doubtless there is something in it, though some employers—and some of the general public too—may say not. However, strikes malingering and such things may be caused, more than we think, by our external attutude towards that section of the community we designate by the general word "Labor," which is exceedingly sensitive and perhaps apt to read into the more or less brusque and preoccupied manner of the office man or the employer something in the way of offense or superciliousness that has no trace whatever in fact. For, generally speaking, the average citizen respects his fellow for the type of man he is, and not for his money, position, or occupation. A bricklayer may not be entirely congenial to a banker, or vice versa, but this does not prevent either of them from winning and holding the respect of the other.

The difficulty is not so much, we believe, that there is any real antagonism between classes as that each finds it difficult to make himself understood by the other. "Labor" is rough and often dirty and the banker is apt to think of his instincts and thoughts as being the same way. The banker type is associated in "Labor's" mind with ease, wealth and freedom from care and, not understanding him, "Labor" labels him as indifferent and arrogant.

The fact is that among both "Labor" and "Banker" there are many sterling characters. The Rotarian who wrote the above extract doubtless had it in mind that every class in the community might look a little closer to find the good in the other classes and blind its eyes in a like degree to the bad; also that we should be less prone to judge by external appearances or mannerisms and carefully sound a man out before we form a definite conclusion as to his depth or the quality of his character.

It is doubtful if either side can throw stones. If the aim of the Rotarians is along the line of clearing away the misunderstandings between class and class they are engaged in a great work.

Will This be Canada's Biggest Building Year?

According to a tabulation made by MacLean Building Reports it is shown that, on the average, 50.7% of the total building construction contracts are awarded during the first six months of any year and 49.3% during the last six months. This is the result obtained by averaging the last twelve years. Month by month the average of the last twelve years gives the following percentages:

	Per Cent. of Yearly Total		Per Cent. of Yearly Total
January	3.9	July	9.8
February	5.	August	9.7
March	6.8	September	8.9
April	11.2	October	8.6
May	12.3	November	6.8
June	11.5	December	5.5

It is interesting to note where this reasoning will lead us to at the end of 1922. The construction contracts awarded in Eastern Canada in July this year amounted to $21,076,000; in Western Canada $5,618,200 a total of $26,694,200. If this represents 9.8% of the total year's construction, then our grand total for the year will be $272,389,796., and the number of contracts yet to come amount to about one hundred and ten million dollars.

The Koehring Company, Milwaukee, are distributing an exceedingly artistic booklet entitled "Built to Endure." It illustrates and describes briefly a number of comparative examples of notable ancient and modern pieces of construction work, all embodying the elements of permanency.

Renewed Activity on the Government Dry-dock at Esquimalt, B.C.

All Dredging and Earth Excavation and Half of Rock Removal Now Completed—Large Mud Hole Requires Filling—Second Cofferdam Well Advanced—Very Complete Construction Plant

By J. B. HOLDCROFT, A.M.E.I.C.
Contract Record Correspondent

Following the authorization recently received from Ottawa, work is now once again in full swing at the Dominion Government dry-dock at Esquimalt, B. C., and the work is rapidly being carried through the preliminary stages. The Pacific Construction Co., Ltd., sub-contractors to the P. Lyall & Sons Construction Co., general contractors, announce that dredging, of which there was 81,000 cu. yds., is now complete, as is the earth excavation, of which 20,000 cu. yds., has been handled.

Rapid progress is being made with the rock excavation, of which there is a total of 325,000 cu. yds., which is likely to be increased somewhat by overbreak. Of this total, 165,000 cu. yds. has been taken out to date, the material having been used to make the fill for the landing wharf outside the dock area.

Deep mud hole found in main excavation. This will involve 5,000 cu. yds. extra of mass concrete to make good to floor level

An additional quantity of rock excavation of 25,000 cu. yds. is contained in the item for trenches, on which a commencement has not yet been made. This part of the work represents the water channels to be constructed under the dock floor level for emptying and filling, which will be connected with the pump house, for which a large separate excavation is being made, to the north of the dock itself.

One of the problems which have developed in connection with the excavation is a deep mud hole at about the location of the first sill, extending to a depth of 15 to 20 feet below the level of the dock. This is being excavated to solid rock, and will be refilled with mass concrete to grade, of which it will take about 5,000 cu. yds. As the hole is close to the side of the dock excavation, it has been found necessary, as a preliminary measure to complete excavation, to build a retaining wall along the toe of the inner cofferdam, which is very close to the edge of the hole.

General view of main excavation, showing incline with hauling engine at the top. Inner cofferdam just beyond steam shovel

Bucyrus shovel in main excavation

Cribwork

An important item of the contract is the cribwork. These cribs, of which a total of seven or more are to be installed are constructed of timbers 12″ x 12″ in section, and are 40′ x 100′ in plan and 35′ in height. The first ten feet in height of each crib is being built on a slip by Messrs. Yarrows, Ltd., at their shipyard a short distance from the work, after which they are launched and the rest of the timbers added near the site by the Pacific Construction Co.'s forces. Each crib is enclosed in concrete, fully reinforced. A thickness of two feet is placed on the side which will finally be exposed, and one foot on the other three sides. Two cribs have been finally completed and sunk in place on the outer line of the landing wharf. Two more are now being concreted, and a fifth is being commenced on the ways. There is a total of 40,000 cu. yds. of this item, and the work is regarded as 75% complete. The concrete sheathing amounts to 4,400 cu. yds., and the top wall, not yet commenced, will amount to 3,300 cu. yds. of concrete. Concrete lining of the dock proper will amount to over 125,000 cu. yds. and has, of course, not been commenced.

Driving steel sheet piling on line of outer cofferdam

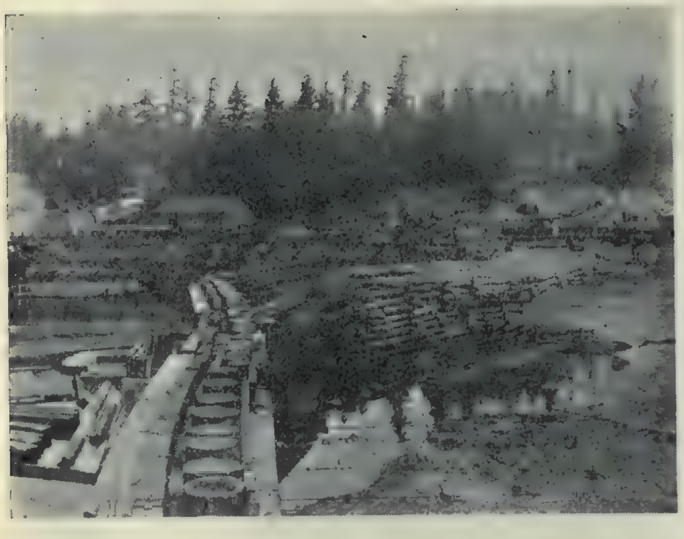
Work is now well advanced on the construction of the second and outer cofferdam. This will be 1,000 feet in length, and when completed will, with a portion of the first dam to which it is joined, permit the complete unwatering of the dock area. The general construction of this dam is an earth and rock fill with a core or cut-off wall of Lackawanna Steel sheet piling. Over 2,000 tons of steel will be used for this purpose, mostly in 75 foot lengths. For a distance of approximately 300 feet from the junction of the dam with the landing wharf the steel piling is driven down to rock and cut off at the level of the top of the dam. The oxy-acetylene torch is being used for this purpose, and also for the purpose of cutting holes through the web at the top to furnish a hold for pulling the piling when that is required. This is a very economical and satisfactory method for the purpose.

Beyond the first three hundred feet of the dam, the rock runs so deep that no attempt will be made to reach it with the steel, and the seventy-five foot lengths will be driven full length into the clay stratum. It is expected that this will furnish ample strength for the purpose. A trestle on wooden piles is being erected over the full length of the dam, and is being used in the first place to support the steel piling during driving. Track is being laid on it and the rock and earth filling will be dumped direct from the excavation trains as they come from the steam shovels. The sheet piling is being placed by the Lyall Company's forces, but the rock and earth portion of the cofferdam is being supplied by the sub-contractors.

First two cribs in place. Bottom being leveled up by dumping rock from a scow for further sections. Photo taken from edge of fill

The Pacific Construction have a very complete and efficient plant on the ground. Power is brought on to the site from the transmission line of the British Columbia Electric Railway Co., which is near by, at 18,000 volts, and the voltage reduced to 2,200 volts by a 333 k.w. transformer. The power is used almost entirely for driving the air compressors, of which there are two. The main unit is a Bury two-stage compressor with a capacity of 1,500 cu. ft. of air per minute. Pressure is maintained at about 110 lbs. per sq. in., and the unit is driven by a 300 h.p. synchronous motor, direct connected. A concrete base has been installed. An auxiliary unit is a belt connected

Concreting plant placing sheathing on floating cribs for landing wharf wall



North shore end of inner cofferdam. Timber sheet piling was used. Cables proved to be necessary to prevent mud fill crowding the piling outwards during low water stages.

Ingersoll-Rand compressor with a capacity of 500 cu. ft. of air per minute, driven by a 150 h.p. motor.

Seven tripod drills and eight Jackhamers are run off these compressors. The material is almost entirely handled by steam shovel, of which three are kept employed. These are a Bucyrus 70, a Marion 35 and a Marion 25. About a mile of 3 ft. gauge track leads from the various faces to the dumps and the equipment consists of 36 side dump cars of 4¼ cu. yd. capacity, with five dinkey locomotives. Six car trains are the rule.

To assist the trains up the incline out of the big hole, a Willamette steam logging engine has been installed. This is a 10" x 11" engine with tandem drums. The cable from the drum is passed around a large sheave some distance from the head of the incline, the engine itself being located at the edge of the dip so that a signalling system is unnecessary, the operator having a clear view of the work below.

Two large stiff-leg derricks are also being employed. One of these is located over the pump-house excavation, and is of 15 ton capacity. The other is at present being used over the mud hole in the main excavation, of which mention was made previously, and is of 5 ton capacity. The floating equipment consists of two clamshell dredges and a concrete mixing plant, which is now in use for placing the sheathing on the timber cribs forming the landing wharf wall.

Mr. J. H. Halpin is superintendent on the ground for the Pacific Construction Company, and F. Bagshaw is engineer for the same. Messrs. Lyall & Sons are represented by G. H. Pethick as superintendent and W. A. Gourley is resident engineer for the Dominion government.

Regulations Needed to Reduce the Compressed Air Hazard

The Prevalence and Seriousness of Caisson Disease is Leading to the Study of the Subject With the Object of Suggesting Suitable Precautionary Measures

By W. G. CAMERON, B.A.Sc.

Assistant Engineer, Sewer Section, Works Department, Toronto

The Bureau of Mines at Washington, D. C., is making the first real study, under Dr. Edward Levy, of the causes and nature of the caisson or compressed air disease yet attempted on this continent. There has been very little real interest shown in the study of this condition, and the pioneer sufferers had to suffer in silence, or, what is worse, hear others, especially those who had no such experience, ascribe their illness to some other cause. Of course considerable study of the subject has been made in Europe where construction of this nature is so much more advanced than it is here; but so far as is known, the study has been confined to high pressures giving almost immediate results, while little if any study has been made of the injuries caused by low pressures, and no investigations, so far as is known, have been made to determine at what pressure compressed air begins to take effect on or cause injury to the human system. Of course, this study is becoming very important now that compressed air is becoming so widely used and is of such enormous economic value. Some of our modern work in tunnels, such as those of intercommunication between large centres, subaqueous work and caisson sinking, would be impossible without compressed air to force back the water. There are few large centres nowadays which have not experienced some compressed air work. For example, in Toronto its use to aid in sewer tunnelling has been almost continuous since its first appearance in 1913, and the pressures used have varied from 5 to 25 lbs.

It would seem that in all cases where compressed air is to be used, rules governing its use should be drawn up. These rules would include those governing the class of men to be employed. So far it has been considered that the cause of sickness has been too rapid decompression, bringing on vertigo, difficult breathing, localized pains and affections of the central nervous system and hemorrhages. The men most susceptible to these ailments are those of a fatty nature, with high blood pressure, weak lungs, heart, kidneys or stomach. Where high pressures are used, a medical lock should be provided in any case when a man shows symptoms, and a man thoroughly familar with these cases should always be present. The victim should immediately be taken back and re-compressed, and then after a few minutes be brought back very slowly to the atmospheric pressure.

In most cases, where sicknesses have become widely known, with their causes, we have established rules governing them, but in this case there is, except in such cases as New York, no warning given nor posted nor in any way is there any effort made to protect the individual and considering the seriousness of the situation this is a very pressing need.

Construction Developments During the Month of July

Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded and Contemblated

Construction Contracts Awarded in Eastern Canada, July, 1922

	Ontario		Quebec		New Brunswick		Nova Scotia		Eastern Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	6	$ 68,000	....	....	1	$ 12,000	...	....	7	$ 80,000
Churches	8	193,000	1	$ 55,000	1	15,000	1	$ 35,000	11	298,000
Factories	14	1,020,000	4	53,000	....	....	1	200,000	19	1,273,000
Public Garages	20	188,300	19	103,900	....	....	1	6,500	40	298,700
Hospitals	1	10,000	...	....	....	....	....	....	2	25,000
Hotels and Clubs	4	25,200	....	....	1	2,000	1	5,600	[illegible]	32,800
Office Buildings	4	278,800	1	6,000	..	....	...	....	5	284,800
Public Buildings	10	293,100	2	960,000	.	....	....	....	12	1,253,100
Residences	1127	5,446,900	312	1,690,500	20	129,000	79	347,400	1543	7,633,800
Schools	36	1,335,400	11	953,000	3	220,000	...	..	50	2,508,400
Stores	64	848,000	18	260,500	2	9,000	3	17,500	87	1,135,000
Theatres	1	4,000	....	....	1	15,000	...	....	2	19,000
Warehouses	9	778,000	5	178,000	...	....	1	5,000	16	960,000
Total Buildings	1304	$10,488,700	373	$1,254,900	29	$402,000	87	$ 617,000	1800	$15,803,300
Bridges	8	$ 45,100	8	$ 129,600	6	$ 142,600	1	$ 2,000	23	$ 319,300
Dams and Wharves	1	6,000	2	254,500	1	39,000	1	25,000	5	324,500
Sewers & Watermains	17	245,400	....	....	....	....	....	....	17	245,400
Roads and Streets	25	876,500	3	85,000	....	....	3	50,000	31	1,011,500
General Engineering	15	3,372,000	....	....	....	....	.	....	15	3,372,000
Grand Total	1370	$15,038,700	386	$4,724,000	36	$583,600	92	$694,000	1891	$21,076,000

Construction Contracts Awarded in Western Canada, July, 1922

	British Columbia		Alberta		Saskatchewan		Manitoba		Western Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	1	$ 7,000	....	....	....	....	....	....	1	$ 7,000
Churches	2	14,000	2	$ 28,000	3	$ 76,200	5	$ 88,400	12	206,600
Factories	7	96,200	2	17,000	....	....	2	11,600	11	124,800
Public Garages	4	49,000	2	6,400	2	10,500	5	27,800	13	93,700
Hospitals	....	....	....	....	1	7,600	1	23,000	2	30,600
Hotels and Clubs	4	23,500	3	44,000	....	....	....	....	7	67,500
Office Buildings	3	13,000	3	11,000	2	22,000	2	115,000	10	161,000
Public Buildings	1	6,700	1	3,000	....	....	2	5,900	4	15,600
Residences	144	566,800	50	184,500	77	222,100	178	738,500	449	1,711,900
Schools	10	114,900	5	18,900	10	61,500	3	32,300	28	227,600
Stores	17	113,000	13	147,300	3	42,800	15	71,800	48	374,900
Theatres	1	14,000	....	....	....	....	....	....	1	14,000
Warehouses	2	14,000	5	105,600	2	20,500	....	....	9	140,100
Total Buildings	196	$1,032,100	86	$565,700	100	$463,200	213	$1,114,300	595	$3,175,300
Bridges	4	$ 112,000	5	$ 13,000	....	....	5	$ 5,000	14	$ 130,000
Dams and Wharves	4	1,547,800	....	....	..	....	....	....	4	1,547,800
Sewers & Watermains	1	1,900	2	25,700	1	3,700	5	12,300	9	43,600
Roads and Streets	7	337,800	....	....	7	131,000	3	96,900	17	565,700
General Engineering	....	....	....	....	1	75,000	2	80,800	3	155,800
Grand Total	212	$3,031,600	93	$604,400	109	$672,900	228	$1,309,300	642	$5,618,200

Contemplated New Construction Work in Canada, July, 1922

	Ontario		Quebec		Maritime		Western		Dominion	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	3	$ 159,000	1	$ 40,000	..	....	..	....	4	$ 199,000
Churches	11	215,000	3	66,000	2	$ 21,000	5	$ 131,600	21	433,600
Factories	10	725,000	2	1,020,000	1	15,000,000	7	4,104,000	20	20,849,000
Public Garages	10	292,000	3	46,000	2	23,000	4	84,000	19	445,000
Hospitals	.2	80,000	1	30,000	....	....	6	195,000	9	305,000
Hotels and Clubs	3	298,000	2	95,000	2	20,000	4	50,000	11	463,000
Office Buildings	5	90,000	2	45,000	1	10,000	2	12,500	10	157,500
Public Buildings	9	61,500	...	....	2	25,000	6	108,500	17	195,000
Residences	141	840,000	32	306,000	19	82,300	116	390,600	308	1,618,900
Schools	33	1,068,000	17	141,500	2	92,500	46	340,000	98	1,642,000
Stores	21	345,500	2	75,000	....		13	136,500	36	557,000
Theatres	1	150,000	....	....	1	20,000	3	24,000	5	194,000
Warehouses	5	129,000	....		1	30,000	5	49,000	11	208,000
Total Buildings	254	$4,453,000	65	$1,864,500	33	$15,323,800	217	$5,575,100	569	$27,216,400
Bridges	20	$ 250,300	5	$ 93,000	6	$ 53,500	8	$ 77,200	39	$ 474,000
Dams and Wharves	3	41,000	3	61,900	3	62,500	2	8,000	11	172,500
Sewers & Watermains	32	541,500	7	187,500		....	12	150,500	51	879,500
Roads and Streets	44	729,700	22	844,100	....	....	14	354,100	80	1,927,900
General Engineering	4	60,000	1	20,000	....	....	8	220,000	13	300,000
Grand Total	357	$6,075,500	103	$3,070,100	42	$15,439,800	261	$6,385,200	763	$30,970,600

Concrete for Water-Holding Structures

Special Problems in the Use of the Material for Such Purposes—It is Possible to so Use Concrete as to Make it Waterproof of Itself —Considerations to be Taken into Account in Designing

By H. C. RITCHIE

Read before the Institution of Water Engineers

It will be readily agreed that, generally speaking, reinforced concrete can be usefully employed in the structural works of the water engineer, and these works for the purpose of consideration must be divided into the two separate classes—namely, water-retaining structures and general structures which are not water containers.

In the former class we have dams for impounding reservoirs, gauge basins, conduits, service reservoirs, water towers, filter beds, well linings, etc., and in the latter we have bridges and buildings, retaining walls, coal bunkers, and the many other subsidiary works such as are involved in any large waterworks undertaking.

It seems somewhat remarkable that we have seen the progress of reinforced concrete more marked in fields of structural engineering other than our own, particularly in the field of building construction coming under the control of the architect rather than the engineer.

Now the author here wishes to emphasize that neither the British architects' recommendations nor the London County Council regulations, although both fairly comprehensive in respect of ordinary structural work, cover the case of water-holding structures, and that, in fact, tanks, reservoirs, conduits, etc., even though designed in strict compliance with such data, might be anything but satisfactory.

Special Problems

The design of water-retaining structures in reinforced concrete has its special problems calling for careful consideration, but so far no definite recommendations have been put forward nor rules laid down by any responsible body of engineers for the guidance of those who wish to avail themselves of the advantage of this material in the construction of such works.

It is true that the Committee on Reinforced Concrete set up by the Institution of Civil Engineers issued two reports in 1910-13, the latter of which particularly contained much valuable information affording considerable help to engineers engaged upon the solution of the problems referred to, but these reports gave food for further thought rather than definite recommendations.

The committee clearly recognized that the data upon which reinforced concrete designs should be based must vary very considerably over the very extensive range of conditions to which the structures woud be subjected, and it was emphasized that rules of calculation, such as those recommended by the R.I.B.A. Committee, must be used "with due perception of the basis upon which they stand, and the limitations within which they may be safely applied."

As you are aware, the general theory of design of reinforced concrete is based upon the assumption that concrete offers no resistance to tensile stress, and as its strength in tension is neglected, it is considered safe to assume that steel rods embedded therein may be stressed up to 16,000 lb., or even as high as 20,000 lb. per sq. in., without detriment to the structure.

It is assumed further that the moduli of elasticity of both steel and concrete are constant, so that the modular ratio is constant, and this value is taken at from 10 to 15 for the qualities of concrete used in this class of work.

From these assumptions it follows that before the 16,000 lb. per sq. in. stress on the reinforcement can be reached, the concrete surrounding the steel must have cracked; as the corresponding stress in this concrete, taking the higher modular ratio of 15, would be in excess of 1,000 lb. per sq. in.

So far as actual structural soundness is concerned, this condition of the concrete is not detrimental, because of the original assumption that it has no tensile strength; but at steel stresses approaching the maximum allowable under either the L.C.C. regulations or the R.I.B.A. rules, this cracking, however minute and distributed, is of such a character as to render structures incapable of holding water without undue leakage.

Leakage Trouble

This has been appreciated only as the result of practical experience, and the author personally can recall several instances of water-containing structures with which he was associated where very troublesome leakage was experienced in spite of the fact that the very best materials and workmanship were employed, and the difficulty of appreciating what was happening was increased by the fact that there were no visible cracks or defects in the concrete. Rendering the water surface with a rich mixture of sand and cement did not appreciably improve matters, and the tanks were never made really watertight until a plastic inside coating had been applied.

This gave strength to the general impression that neither Portland cement concrete nor even a rich mixture of sand and cement could of themselves be made watertight; but this erroneous idea was disposed of by the results of tests on plain concrete slabs; so that attention was directed to a closer investigation of the stresses in water-holding structures.

The first step taken was to reduce the allowable stress in the reinforcing steel, and this was gradually brought down to about 11,000 to 12,000 lb. per sq. in., at which some very satisfactory results were obtained.

The success of tanks so designed, however, was variable, the results obtained in some cases being highly satisfactory, whereas in other cases, where the same tensile steel stress had been adopted and where equally good materials and workmanship had been employed, the results were disappointing. It was then fully appreciated that, for this class of structure, the theory of design based upon the assumption that the tensile stresses in the concrete might be ignored was totally inadequate, and, in fact, that their investigation must be the primary consideration.

Some most useful tests in this connection were conducted for the Civil Engineers' Committee in reinforced concrete with a view to ascertaining the tensile efficiency of concrete and cement mortars relative to their crushing strengths.

Slabs were cast simultaneously with sets of cubes representing the same mixtures of concrete, and at six months the cubes were crushed in the usual way to ascertain their value while the slabs were loaded as beams; and from the breaking loads on definite spans the ultimate tensile stress was deduced by the usual formulae.

Ratio of Stresses

The results showed that for 2 to 1 cement mortar the mean ultimate tensile stress was 835 lb. per sq. in., as against a mean ultimate compressive stress of 2,412 lb. per sq. in. A ratio of 1/2.88. For the 4: 2: 1 concrete, the figures deduced were 588 lb. per sq. in. in ultimate tension and 1,460 lb. per sq. in. in ultimate compression. Ratio 1/2.48.

These ratios compared well, although they were high, and as the tensile tests were indirect, being induced by loading the slabs as beams, with their supports bedded in plaster of Paris, which would doubtless act to a certain extent as abutments supporting arch action in the slabs, some allowance must be made on this account in aiming at a reliable ratio. Taking the average tensile results obtained from the 2 to 1 cement mortar slabs—viz., 835 lb. per sq. in. at six months—it is seen to be approximately double the value given by direct tensile tests on small specimens, so that it seems reasonable to infer that the ratios given by these experiments should be halved, giving a ratio of actual ultimate tensile resistance to ultimate compressive resistance of concrete at approximately 1/5, a value which is probably very near the mark for an average concrete.

Other results available at that time, however, as well as results more recently obtained, show great divergence in the values given for this ratio, which varies very considerably with the character of aggregate and sand as well as the proportions of the concrete mixture.

The best results obtained gave as high a ratio as 1/4, and the poorest approximately 1/10, a higher tensile relative to compressive resistance being given where a cubical rather than a rounded aggregate is used, and after a short period of maturity rather than after a longer period.

The author's practice in the design of water-holding structures is to consider primarily the stresses on the composite sections of steel and concrete, keeping the unit tensile stress within the limit which experience has shown will yield water-tightness.

In cases where direct tensile stress in the concrete is to be considered this should not, in his opinion, be allowed to exceed 10 per cent. of its ultimate compressive resistance at thirty days, which for a 3: 1½: 1 concrete would give 200 lb. per sq. in. and for a 4: 2: 1 concrete 160 lb. per sq. in., giving a ratio of working tensile stress to ultimate compressive stress at four months of 1/15.

Where the tensile stresses are induced by bending his experience has been that these allowable theoretical stresses can, with safety, be doubled, on account of arch action.

Observance of these stress conditions, although assuring the water-tightness of the concrete, does not necessarily give a structural factor of safety against failure, and this must be provided for on the basis of the usual data for reinforced concrete design, but limiting the assumed tensile stress in the reinforcement to from 9,000 to 12,000 lb. per sq. in., depending upon the quality of concrete, the relative proportion of steel to concrete in the section under consideration, and also upon the head of pressure to which the structure will be subjected.

Limiting the Steel

In circular reservoirs designed for hoop tension, it is most important to limit the percentage of steel to concrete, not only on account of the considerations referred to above, but also on account of it being necessary to obtain continuity of the reinforcing hoops by means of lapping them in the concrete, which must be relied upon to transmit the tension from one bar to the next forming the circle. This has been found to be a very highly important consideration.

The generally accepted data for structural design in this material ignores the stresses set up in steel and concrete, due to reduction in volume of the concrete on setting and maturing. These are, of course, tensile stresses in the concrete and compressive stresses in the steel, and while it is perfectly safe to leave these out of consideration in ordinary structural work, they cannot be ignored in the case of structures designed for holding water.

If no provision is made to relieve these stresses, cracking will certainly occur wherever there are extensive surfaces of concrete, and although reinforcement may be added to reduce the tendency to crack, or, rather, to extend the distance between cracks, it must be recognized as inevitable that cracking will occur, and the only way to overcome this with a view to ensuring water-tightness, is to encourage the cracks to take place in pre-determined positions where special provision may be made to retain the water. In other words, provide expansion or contraction joints.

In ordinary structural work these contraction cracks as a general rule take place at the planes of stoppage of a day's concrete work, which is naturally the weakest section, so far as resistance to tensile stress is concerned.

It is a simple matter, therefore, in reservoir work to define the planes of stoppage and to form these into expansion joints by any of the means indicated in the accompanying diagrams.

In order to make sure that the section through such joint shall be the weakest section the concrete may be grooved immediately over the butt joint so long as care is taken to ensure that the nett sectional area at the joint is sufficient to take the compressive stresses which it will be called upon to resist, and in the case of a slab subjected to bending, the groove should be formed on the tensile side.

Spacing of Expansion Joints

Opinion as to the proper and effective spacing of expansion joints differs, and some reinforced concrete engineers claim that they are unnecessary up to lengths of 60 ft., but the author, from his own experience, would say that 25 to 30 ft. is sufficient space to allow in work where complete water-tightness is essential.

He has also noted that contraction cracks do not often become observable until three to four months have elapsed after the placing of the concrete, but this period varies considerably, and obviously depends upon many factors, such as the original condition of the concrete when placed, whether a dry or wet mixsure, and the atmospheric conditions during the maturing process.

Concrete immersed in water expands considerably, so that in the case of comparatively small reservoirs and tanks occupying a short period of construction and which can be filled within, say, three months after the placing of the first concrete, expansion joints can with safety be dispensed with.

Experiments carried out by the Office of Public Roads of the U. S. Department of Agriculture showed that a 4:2:1 concrete, which contracted 0.0002 in. per in. after three months maturing in air, expanded 0.00014 after three months immersion in water, indicating a nett contraction of 0.00006, corresponding with a tensile stress of 120 lb. per sq. in. in the concrete, and after five months immersion in water had expanded 0.00002 in. per in., equal to the three months contraction on maturing in air.

Concrete matured in air for longer periods continues to shrink, and therefore where some time must elapse between the placing of the first concrete and the filling of the reservoir, expansion joints are essential to ensure freedom from leakage.

The provision of such joints serves also to relieve the structure of the stresses due to temperature changes.

Circular Tank is Economical

So far as the author's experience goes, he has found that in reinforced concrete the circular tank or reservoir is the most economical in cost for diameters not in excess of about 140 ft., and this type is always the least difficult to make watertight, the reason being that bending stresses are eliminated and contraflecture is avoided.

This is true only where the bottom of the tank is entirely separated from the wall, leaving the latter to expand and contract without varying restraint. Where the base of the wall is made continuous with the reservoir bottom it will be readily appreciated that a restraining moment is set up, which will be a maximum at the bottom of the wall and will gradually reduce upwards until a point is reached where its deflection as a vertical beam or cantilever is equal to the change of radius due to hoop tension.

The provision of reinforcement to meet the stresses so set up adds considerably to the cost of the work, and the possibility of cracking is increased very considerably.

Further, it will be appreciated that in reservoirs of larger diameter proportional to depth, the wall would become wholly a vertical beam, so that no advantage could be taken of cylindrical resistance.

From purely structural considerations there appears to be no sound reason why hoop tension should not be relied upon in the design of circular tanks of larger diameter than that referred to, so long as the several conditions specified are carefully observed; but it is obviously most important to isolate the wall, and this is quite simply arranged by means of an elastic joint of similar construction to that illustrated.

In America service reservoirs in reinforced concrete approaching 190 ft. diameter and 30 ft. deep, have been designed and constructed in this way, and the size might, if desired, be extended until such proportions of wall are reached as will render this type of construction more costly than beam and slab construction under any set of conditions and circumstances governing costs in the particular case under consideration.

Making Concrete Watertight

There is probably still a widespread impression that Portland cement concrete in itself cannot be made practically impermeable without the aid of waterproofing compounds, either mixed with the concrete or applied as cement rendering as a finishing face to the concrete.

The Civil Engineers' Committee on reinforced concrete arranged a series of tests which were carried out at the National Physical Laboratory with a view to ascertaining the rate of percolation of water through concrete slabs. A description of the apparatus used, and an account of the results obtained, will be found in Memorandum "B" of the second report of the committee.

The slabs tested were 4 in. in thickness, and the concrete mixtures were 4:2:1 and 2⅔:1⅓:1. The results obtained were not as satisfactory as they might have been, and no account was given as to how, or on what grounds, the proportions referred to were adopted.

Even in the case of the richer concrete percolation under 20 ft. head was, at first, quite rapid, in one case as much as 37 c.c. per sq. ft. per hour. After nine weeks' application the rate of percolation dropped to 0.5 c.c. per sq. ft. per hour, and remained practically constant at that rate up to fourteen weeks, when the test was discontinued.

In the case of the best sample, the rate of percolation after fourteen days was 1.4 c.c. per sq. ft. per hour, dropping to 0.35 c.c. at eight weeks and remaining constant up to sixteen weeks when the experiment was terminated.

Various opinions have been expressed as to the explanation of the time reduction in the rate of percolation, but more recent experiments go to prove that it is to be accounted for mainly by the expansion and consequent closing up of the pores in the concrete, which has been shown to take place when immersed in water. The suggestion that the reduction was due to a silting up process caused by the deposit of calcium carbonate has been found to be only a secondary cause, as a repeated test applied after the concrete slab has been allowed to dry out shows a similar time reduction in the percolation.

Much better percolation results would have been obtained in these tests had there been a more scientific adjustment of the proportions of aggregate and sand, without increasing the proportion of cement, as the secret of success in this direction lies almost entirely in this adjustment, and if water-tightness is to be obtained no arbitrary proportion of sand and aggregate can be accepted.

If a mechanical analysis is made of the sand and aggregate, and their relative proportions in the concrete mixture be adjusted, so that all voids are properly filled, a concrete no richer in cement than the 2⅔:1⅓:1 mixture adopted by the committee should be practically impermeable with a test slab only half the thickness and under a head of pressure at least double that adopted in the tests recorded.

The author, in connection with his own work, has, in fact, produced a concrete corresponding approximately with a 2:1:1 mixture, which on a series of percolation tests carried out by Messrs. David Kirkaldy & Son on slabs 2 in. thick and under 96 ft. head of water pressure remaining on for five days, there has been in no case percolation through the slab, and in many cases the moisture had penetrated hardly more than ¼ in. into the slab.

With a mixture no richer in cement than 3¾: 1⅞: 1, but with proportions of sand and aggregate adjusted after mechanical analysis, he has obtained a concrete which in a 2½ in. thick test slab has resisted a 40 ft. head of water pressure remaining on for six days without the slightest sign of penetration through to the opposite face, and after the test slabs have been broken an examination of the section has indicated the maximum extent of penetration of moisture to be not more than 2 in. in the case of the poorest sample.

It can, therefore, be stated with complete confidence that Portland cement concrete can be made quite watertight if properly gauged, without the aid of any waterproofing compound or special treatment of any kind except care in the mixing, placing and ramming in the work, and, providing that the stress requirements as before described are fully provided for, there is no reason to fear trouble in this direction in tank or reservoir construction in reinforced concrete.

It is, of course, desirable to make provision in design and specification for the disparity between actual works concrete and the concrete of laboratory test pieces, and for this reason it is advisable to adopt a richer mixture of concrete for the internal faces of water-holding structures.

The writer believes that most water engineers dislike cement plaster work, and the chief objection to it—namely, the great difficulty of ensuring its adhesion to the concrete base so as to become integral with it is increased in the case of reinforced concrete, where the material is more "lively" under stress.

The difficulty may be overcome by casting a rich face on the concrete itself, a method which is not only much more satisfactory in its result but actually less costly in construction.

The base concrete may be of from a 4: 2: 1 to a 3: 1½: 1 mixture in accordance with the requirements of the general structural design, and the water face concrete, for a thickness of about 1½ in., may be a richer mixture, say, 2: 1: 1, in which a smaller grade of aggregate is used. The latter is placed first and well worked against the timber sheeting and a temporary sheet-iron diaphragm which rests against the reinforcement. The placing of the base concrete behind the diaphragm follows immediately, and is well rammed and puddled separately. The diaphragm is then withdrawn, and the base concrete finally puddled and worked against the richer concrete facing without disturbing the latter, which has already been finally worked.

(To be concluded.)

The Belgian Industrial Co. Ltd., Extending Their Plant

The construction of a large extension to the paper mills of the Belgian Industrial Company's plant at Shawinigan Falls, Que., is in progress. The new building will be 265 feet long by 112 feet wide. To locate this new building the company is obliged to excavate 45,000 cubic yards of rock. A steam shovel is used, helped by a water jet supplied by two centrifugal pumps, having a capacity of 5,000 gallons per minute under 140 pounds pressure. The pumps are also used as protection in case of fire.

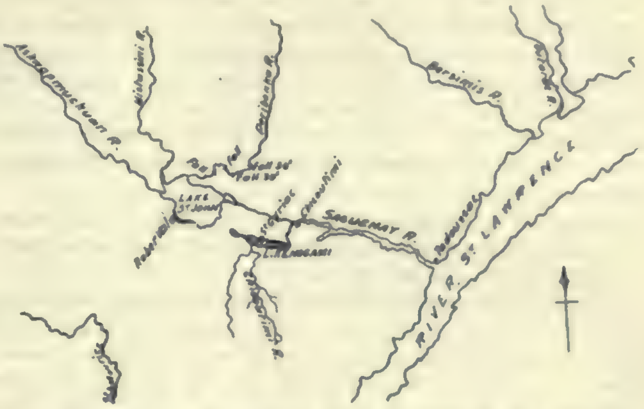
An electric crane operated by four motors, and having a span of 82 feet and a capacity of thirty tons will be installed in the new building. There will also be installed a crane of the same capacity having a span of thirty feet.

The building is designed to contain two paper machine units. Already one has been ordered from Chas. Walmsley & Co. Ltd., of Bury, England. This machine is of the Fourdrinier type and will manufacture a sheet of paper 215 inches wide at the rate of 700 feet per minute. This machine will be operated by a sectional electric drive; 800 horse power are required. The company contemplates the completion of one new unit by the month of January, 1923, and has under consideration the purchase of the second unit to be put in operation in October, 1923.

River Improvements in Quebec

It is announced that further considerable river improvements are to be undertaken next fall in the Lake St. John region, by the Quebec Streams Commission. It is intended to start in the near future, the construction of a dam to control the waters of the Sable and Chicoutimi rivers, feeders to Lake Kenogami. The accompanying map shows the location of the projected works together with the lake and rivers affected.

It is proposed to raise the level of the lake 23 feet, storing enough water to create sufficient additional power for the Chicoutimi Pulp Co., to operate their mills 12 months in the year instead of nine as at present, thereby giving work to their 2,000 employees all the year round.



Map of Lake St. John district where improvements are projected

The proposed works are estimated to cost approximately $2,000,000 besides another half million dollars to land owners of the village of St. Cyriac, a great number of whom will likely suffer damage due to the increased level of the lake.

Police Chief Wants Wider Roadways

Following close upon the action of the recent Good Roads Congress in Chicago which, in a resolution, declared for a minimum width of twenty feet for highways, and that of the Asphalt Association which took similar action, in deference to increasing traffic, the national convention of police chiefs, held in San Francisco recently, adopted a resolution demanding wider streets and roads so as to faciliate the regulation of traffic. It was felt, narrow streets not only induce accidents but are big factors in traffic tie-ups.

Procedure in Estimating Buildings

Introductory Chapter of the "Building Labor Calculator" Recommends Method of Preparing the Estimate Sheet and Listing the Various Items Involved

By G. M. TAMBLYN

In preparing what I have termed Constants of Labor I am not unmindful of the many elements that enter into construction that will make the actual cost of work vary from the most carefully prepared estimates. For the last fourteen years I have devoted fully two-thirds of my time to compiling estimates for contractors on jobs that range from thousands to millions, and without any desire to advertise matters on which modesty would suggest silence, but merely to establish confidence in those who may be strangers to me, I will add that during the fiscal year just ended I have completed my own contracts, amounting to a quarter of a million dollars, on which only about 3 per cent. was sublet. The work above mentioned was estimated on the basis of the constants included in this article, and while some variations occurred in the actual costs as compared with the estimates, yet as a whole the variations were less than 2 per cent. Therefore, I confidently recommend these constants of labor as reliable and under average conditions and organization the contractor who uses them will appreciate their value.

Builder's work consists of two main items: quantities of material and quantities of labor. Materials of differing grades and prices are subject to change in different localities. Labor of different classes, skilled and unskilled, vary in grade and price also.

Material may be said to be a fixed quantity measured from the plans and its quality fixed by the specifications.

Labor is a variable quantity; its unit is the hour. The quantity varies greatly, due to numerous reasons well known to contractors.

Labor requires much more skilled supervision today than twenty years ago. Now, men pick up their trades to a great extent. Then it was obtained under contract. The constants given in the following pages may serve for a year or two, but unless something is done to train new recruits to fill the declining ranks of skilled laborers, output will continue to decline and the constants will require revising.

A Law of Averages in Contracting

In spite of the variableness of labor's output there is a law of averages which, if carefully tabulated, has the best guess in the world beat. In the same manner insurance companies base their premiums on averages, taking into consideration losses in areas where epidemics reign and probable profits where the mortality is low, over a period of years. So labor's output can be averaged and conservative estimates are made which though subject to variations come out with the total estimate with surprising accuracy.

Since labor estimates are based on the amount of material to be handled, it is very important that correct methods of listing be employed. It makes no difference how close the labor constants may be computed, unless the material bill is correctly entered into the estimates, a difference will show up in the payroll as compared with the estimate. For this reason I will outline what I believe to be correct methods of listing, and will give a few points that I have found to be helpful in striving for accuracy.

Probably more mistakes are made in listing materials than in any other operation connected with making an estimate, and the reason mistakes are thus made is due oftentimes more to lack of system than to lack of knowledge.

It is not my object to go into minute details as to what should be listed, but to suggest a few particular points I have found to be of great help in making estimates. All of these points tend to lessen the danger of overlooking or duplicating items.

We have often heard it said of the contractor who is "low bidder" that his first thought is: "What did I leave out?" He notes that other bids on the same work are a good deal higher than his; he knows he priced the job carefully, and his extensions and footings were checked, and naturally he thinks the only mistake he could have made is to have omitted something in listing.

Sometimes a general contractor will find after he has been awarded a contract that one of the sub-contractors, whose figures he has used, has made a mistake and wants to be relieved of responsibility by withdrawing his figure. This puts the general contractor up against a probable loss if he has signed up for the job. I have known instances where general contractors have withdrawn their bid, or refused to sign up a contract, giving as a reason that one of the sub-contractors, whose figures he had used, had made a mistake. This is purely "passing the buck." Any contractor who puts in a bid based on sub-bids that he has not checked can be judged as incompetent or guilty of gross neglect.

Why Bids are Too Low

Various reasons are given by contractors for making bids too low, few of which are valid. I will give two that are common:

1. Incomplete plans and indefinite specifications.
2. Lack of information regarding local conditions.

No contractor, who knows his business, would submit a close bid on an incomplete plan, or one that did not fully represent the work that it is evident should be done, neither would he put a close price on material that was not clearly specified, unless he wanted to take a gamblers' chance.

The fact that a contractor submits a bid to do a certain job according to plans and specifications, should be taken as evidence that he fully understood each point, and he should carry out the evident intent of the plans and specifications without quibbling over small matters after the work is well under way.

If the plans are incomplete, or the specifications indefinite, it is certain the contractor is left in doubt, but there is no excuse for setting a price on an unknown quantity or quality. The contractor should go to the architect and settle all questions definitely, and have a clear understanding before submitting his bid, and then see to it that the contract is written on the same basis as the bid was submitted.

What I have to say in regard to system in estimating has reference to complete general estimates in particular. I do not think the average sub-contractor who only figures one branch of the work, can possibly understand the plans, or make as accurate a quantity list as the general contractor who figures each branch of the work.

Estimating Procedure

Before you can do any listing it will be necessary to study the plans to get a correct idea of the job as a whole, and the following items should be entered on your estimate as a description of the building. You will find these dimensions will be valuable in many ways. For convenience of description let us take a two-storey school building as an example. Length of building 150 ft.; width of building, 50 ft.; two-storey and basement . Give the following description:

Perimeter	400 ft.
Area building covers	7,500 sq. ft.
Basement cement floors	7,000 sq. ft.
First and second floors, 2x10—16-in. o. c., area	14,400 sq. ft.
Roof measuring to outside of walls	7,500 sq. ft.
Basement walls, 16-in. concrete to grade	
First and second story walls, 13-in., brick.	

Any items that will more clearly defiine the nature of the work should be noted . Writing them down assists greatly in memorizing.

To acquire speed in listing a job it is imperative that memory be cultivated . Practice will make it possible to memorize a specification with about one reading.

Having written a rough description of the building you now take the specifications, and beginning at the first branch of work you read this branch alone and make general notes of main points in the memorandum margin of your estimate sheet. These notes will probably read approximately as follows:

EXCAVATION

Natural grade, 1′ 4″ below finish grade.
Surplus dirt to be carted distance of one-half mile.
Ordinary dirt excavation to 3′ below finish grade.
Gravel from 6′ below grade to lowest point of excavation.
Usable sand 3′ to 6′ below finish grade.
Excavation to be 1′ 6″ clear of outside walls.
Water struck at 8′ below grade.

In order to make an intelligent estimate on the excavation such general points as the above must necessarily be fixed in the estimator's mind before listing can be commenced. Writing them in the memorandum spaces serves the twofold purpose of impressing them on the mind and having them on hand for ready reference.

The order of listing should be the same as the order following in actually doing the work.

First list the main excavation, which should extend to approximately 18 in. clear of the walls all around and to a depth equal to the depth of the bottom of cement floor in basement.

Assuming the bottom of basement floor is 9 ft. below the finish grade, your entry under main excavation would read about as follows:

MAIN EXCAVATION

Ordinary dirt	53′ 0″ x 153′ 0″ x 1′ 8″
Sand	53′ 0″ x 153′ 0″ x 3′ 0″
Dry gravel	53′ 0″ x 153′ 0″ x 2′ 0″
Wet gravel	53′ 0″ x 153′ 0″ x 1′ 0″

Segregating as above provides for intelligent pricing and credits for sand and gravel that can be used in the building. It also makes provision for special consideration of water conditions.

Excavation being one of the most uncertain operations connected with contracting, architects, on work of any importance should, at the expense of the owner, have sufficient test holes dug, readings taken, and made a part of the specification for the contractor's information. The points at which test holes are made should be designated on a plot plan together with the natural grades. Such information is necessary to make an intelligent bid, and whether the architect gives the information or not, no bid should be submitted by the contractor until he has secured the same, or is reasonably sure of the ground from experience on other work adjoining the site.

The next items that should be listed are trenches for wall footings, pier holes, elevator pits, and any other work that goes below the main cellar floor line.

Water should be considered under a separate heading and listed in a manner that provides for intelligent pricing.

Backfilling is usually the last item to be considered. This should be figured and listed separately.

If sheet piling or the shoring of structures adjoining the building site are necessary, these should be treated separately and in detail.

Following the general order of construction, and the lead of the specifications, next comes the concrete footings and walls.

Foundation Walls and Footings

In this particular case that portion of the foundation walls and footings that come below waterline should be listed separately from the portions above water line. If there is any difference in the mix of the concrete, or any points that are difficult of access another separation is necessary and note of same recorded in memorandum or preceding the item.

After listing the concrete, sufficient space should be left blank on the estimate sheet to analyze the component parts of the concrete per cubic yard. For an example, let us take 1:2:4: for the mix specified for the concrete, and 10 per cent. hydrated lime added. You list as follows:

MATERIAL

6 sacks cement, at 80 ct.	$4.80
.45 cu. yd. sand at $1.50	.70
.90 cu. yd. gravel at $2.50	2.25
60 lb. hydrated lime at 80 ct.	48
Water	.10

LABOR

.... hr. common labor.
.... hr. engineer and mixer.
.... hr. foreman.

Fuel and depreciation of plant are charged on a rental basis per hour.

In cases where hoisting engineer is required, etc., analysis must be made according to the method to be used to suit the nature of the work.

Material items are extended in the "material" column of the estimate sheet . Labor items are extended in the "labor" column.

Hauling machinery to job, erecting towers and chutes, dismantling and removing same, should be treated as separate items.

Of course in Construction forms come before concrete, but on account of the fact that the forms can be figured from the dimensions given in the estimate for concrete, the logical place in the estimate is directly after the concrete.

In many instances forms are not required for footings, but since the footings and walls are listed separately there is no difficulty in segregating.

Some contractors estimate form work at so much per cubic yard of concrete. This is practical only where the walls are of the same thickness. The only correct method is by obtaining the superficial feet of surface to be formed, measuring both sides of the walls. After the superficial feet have been determined it is a simple matter to estimate the amount of lumber, wire wire, nails and labor, by using tables and constants of labor in hours.

Brickwork

The next item in order is the brickwork. After carefully reading the specifications and making notes in the memorandum column, proceed to list the brickwork by floors or stories. Always figure the brickwork "net"—"kiln count." Brick that are to be laid in "cement mortar" should be listed separately from brick specified to be laid in "lime mortar." Face brick that are to be laid in special pattern should be listed apart from face brick laid plain . If walls are exceptionally high above adjacent floor, requiring special scaffolding, wind bracing and additional hodcarriers, this portion should be separated and description given covering the condition.

Sufficient blank lines should then be reserved on the estimate sheet to analyze the material and labor required to lay a thousand brick of each kind.

MATERIAL

1,000 brick at $15 at kiln	$15.00
Hauling to site at $2	2.00
¾ cu. yd. screened sand at $1.50	1.12
2 bu. lime at 80 ct.	1.60
Water	.10
	$19.92

LABOR

.... hrs. bricklayers' time at........$........
.... hrs. laborers' time at ....$........
.... hrs. engineer and hoist.
.... hrs. foreman.

Cost of face brick and other classes of brickwork are analyzed in the same manner.

Rough Carpentry

Next in order is rough carpentry. After studying the plans and reading the specifications, list this work, beginning at the foundation and keeping each storey separate, build up in order as follows:

Basement.—Posts, girders.

First Floor.—Joists, bridging, sub-floor, finish floor, stud partitions, grounds.

Second Floor.—Joists, bridging, sub-floor, deadening felt, finish floor, stud partitions, grounds, ceiling joists.

Roof.—Joists, bridging, sheathing, raggle strips, bracing.

Miscellaneous.—Lintels, furring, nails and bolts.

In the memorandum column of the estimate sheet enter the net floor areas for sub-floor. When the board feet of lumber have been totalled from the items listed, it will be found an excellent check to take the area of the sub-floor and multiply by the "multiples" for various sized joints at given centres according to tables I have prepared. Suppose your sub-floor area is 10,000 sq. ft., and the joists are 2x10, spaced 16 ft, o. c. You multiply 10,000 by 1.4 (see tables) which gives you 10,000 ft. B. M. for joists. If your itemized figures vary to any extent from this total you may be sure you have made a mistake in listing. This same method may be applied to stud partitions of roof rafters, providing the net area is known and the dimensions of joists ,studs or rafters. You will find the table can be applied to almost any condition of framing where dimensions are of equal size and spacing.

When figuring the area of floors, walls, partitions, roofs, etc., to arrive at a quantity of lumber, brick, partition tile, roofing, etc., this net area should always be put down in the memorandum column. It will be found very handy later as a rough check on plastering, painting and various other items. The running feet of partitions of various kinds should also be made note of in the memorandum. This, with the perimeter of the building noted at the front of the estimate, serves as a rough check on plastering, base and other items.

Plastering

Assuming you have covered the rough carpentry work, the next operation is the plastering. This branch of work should be listed by floors or storeys. Plastering on brick walls, concrete, tile partitions and general masonry work must be kept separate from plastering on lath. Plastering on wood lath must be kept separate from plastering on metal lath. Rough rubble masonry walls should always be listed separate from brick walls, etc., that have a more even surface. Rubble stone walls usually require a heavy coat of plaster to make them plumb and straight, and for this reason should not be mixed with plastering on other masonry in listing.

Segregating the work as outlined above, figure all walls, partitions, ceilings, etc., "solid." Make no deductions for ordinary openings such as doors, windows, ets. Where cement wainscotts, cornices and such items occur include them in the measurements for plain plaster. Later when wainscott and special plastering is listed separately, credit can be given for plain work already listed.

In listing plastering, like brickwork, make mention and keep separate all items that are difficult of access and which require special scoffolding.

When the list has been completed, make a grand total of all the plastering in the job, and for comparison go to the memorandum column and add up the net areas of all floors (which equal ceiling dimensions) and partitions (multiply by 2 for both sides), and take the perimeter of the building times the height of as many stories as are plastered.. These items added together make an excellent approximate check on the total plaster yardage.

To list plaster on outside walls, take the perimeter of the building on the inside of walls. List partitions by taking the running feet of partitions times 2 sides, times the height. In checking off the plans measure all partitions running east and west and next all partitions running north and south. Start checking off at a given outside wall and check off all partitions to the opposite wall. After you have swept the plan in this direction take all partitions running in the opposite direction. This method is much safer than taking partitions running in opposite directions at the same time. Ceilings should be measured by multiplying the entire length and width of the building inside the outside walls. If certain rooms or spaces are not to be plastered, such rooms or spaces can be deducted from the total area.

Plaster cornices, mouldings, cement base and such items should be listed in lineal feet, giving the girth, and in case of furred cornices, note should be made of the kind of furring and lath, whether wood or metal.

Circular or vaulted ceilings should be separated from plain work. Suspended ceilings should be separated from ceilings lathed on the framing.

All ornamentation on ceilings, walls or cornices must be listed and described separately, and priced as extra over plain work, and where necessary a rough sketch made on the Estimate Sheet to convey the correct idea. The number of models should be made note of as it is usually the big items of expense.

Where plastered window or door jambs are specified with bull nose or corner bead at corners, such corners should be listed in lineal feet.

Sides of "plain plastered beams" should be listed in square yards with additional mention of "arris" in lineal feet.

Corner beads are also listed in lineal feet.

Mill Work

After plastering is completed we next take up "Mill Work" and "Interior Finish." We can only touch on this branch of the work in this connection, and it is my intention only to emphasize a few important points.

First: List all work in connection with the basement, both outside and inside. Your first items should be windows. Imagine yourself on the outside of the building and commence with the window at the right hand side, front, shown on the basement plan and also shown on the right hand side, at grade, of the front elevation. For your further information, this opening should be described as follows:

2 windows 4 lt. 14 in. x 22 in.—1¾ D. S., pine.

1 twin mull, box fr. 22 in. wall, 8 in. reveal, sq. hd. (Standard.)

1 set sub. jambs, clear Y. P.

1 side trim consisting of casings, sash stops, stool and apron, clear Y. P.

2 sets weights and cords.

2 full wdw. screens, 1⅛ in. pine, standard black wire.

Note: 8 in. revel means that the face of the frame sets back 8 in. from the face of the wall and determines the width of sub-jambs and stool.

In listing windows or outside openings of any kind start at the right hand side of the front elevation, and check off the openings in turn, following the direction in which the sun travels crear around the building until you reach the point which you started. As you count off the number of openings of each kind make a check mark on the plan and also a corresponding mark on the elevation. In this way you will be less liable to overlook items. You should never check off openings from the elevations only, for the reason that where courts occur in buildings the openings do not always show up on the elevation. If a window is shown on the plan and for some reason is hidden on the elevation, unless otherwise mentioned or detailed, it is taken for granted the window is of the same height and design as that shown adjoining or similar rooms shown elsewhere. This rule of checking openings both from plan and elevation should never be varied. If you follow this rule it is almost impossible to make a mistake in quantity.

After the windows and casements sash have been listed, the doors should next be taken. Yon are still on the outside of the building and having taken off all mill work except the doors, imagine yourself checking off the outside doors as you enter the building.

Having listed all the outside mill work for the basement from the outside and the outside doors as you entered, the next thing to do is to check off and list the interior doors, sash and any other openings that are finished with wood, and carefully check off all other items of trim or mill work the plans show or the specifications call for. After assuring yourself you have listed all the work in the basement, both outside and inside, you now walk upstairs to the "first" or main floor. Going upstairs suggests "stairs" and you proceed to list these as you go up, checking off and describing as fully as possible.

One reason for listing floors separate is that sometimes to hold the job down to available funds the finish on some floors is omitted. It is an easy matter to give the deduction when listed separate.

Now, having listed the stairs as you came up to the next floor, you walk outside and commence to list windows as described for the basement. Repeat this operation for all floors. Always note the floor you are listing at the head of the material list.

You will find it will help you materially if you imagine yourself actually on the job measuring up and listing the work. You must have a mental picture of the building and see it as clearly in your mind as you see the rooms in which you live.

There are miscellaneous items in connection with this type of building that will be specified and shown on the plans, such as. Roofing, angle iron, iron grills, gratings, etc.; sheet metal, cement walks and steps, stone work, etc.

I will now give a few examples in the use of labor constants without further mention of methods in listing.

EXCAVATION

Ordinary dirt excavation—material to be hauled to dump half mile from building site.

MAIN EXCAVATION

2,500 cu. yd., figure cost as follows

Plow team, 2,500 x .10	250 hours
Team time loading and dumping, 2,500 x .30	750 hours
Team time travelling to dump and back, 2,500 x .50	1,250 hours
Extra snatch team for, 800 x .10	80 hours
Total team hours	2,330 hours
Extra man holding plow	250 hours
Labor shovelling into wagon, 2,500 x .98	2,450 hours
Total labor hours	2,700 hours
Total team time, 2,330 hours, at $1	$2,330.00
Total labor hours, 2,700 hours, at $0.40	1,080.00
Total cost of excavation	$3,410.00

At the above scale of wages, this excavation figures approximately, $1.36½ per cu. yd.

If the above was hauled over paved streets you would reduce the hauling time 25 per cent, therefore, since the travelling time cost 1,250 hours, or $1,250, it would reduce the hauling cost $312.50.

SHEET PILING

Suppose the above excavation were 20 feet deep at the alley and it was necessary to use sheet piling. For an example, say the width is 50 feet and depth 20 feet, this would figure 1,000 square feet of bank to be held.

Table on page 2 of the Constants for 20 feet deep gives 7 feet lumber board measure for each square foot bank, therefore:

1 000 x 7—7M feet B.M., say at $40	$280.00

Labor as follows:

1,000 x .04—40 hours carpenter, at $0.80	$32.00
1.000 x .24—240 hours laborer, at $0.40	96.00

1,000 x .02—20 hours, foreman at $1	20.00	
Total labor cost		$148.00
		$428.00
Salvage on lumber, 50 per cent 3,500 ft., at $30		105.00
Estimated net cost		$323.00

At the above prices of labor and material the cost per square foot is 32 1/3 cents.

CONCRETE FOUNDATION WALLS AND FOOTINGS

326 cubic yards, mixed 1:2:4

Material

326 x .90—293 cu. yd. gravel, at $2	$ 586.00	
326 x .45—146 cu. yd. sand, at $1.50	219.00	
326 x 6—1,956 sacks cement, at $0.80 net	1,564.80	
Water for 326 yards, at $0.10	32.60	
		$2,402.40

Labor

Using small mixer

326 x 2.25—733½ hr.common labor, at $0.40	$293.40	
326 x .20—65 hr. mixer and engineer, at $2	130.00	
326 x .20—65 hr. foreman, at $1	65.00	
		$ 488.40
Total cost material and labor		2,890.80

At the above price of material and labor, the cost per cu. yd. is approximately $8.25.

WALL FORMS

17,564 sq. ft. wall forms, wall surface measure

Material

17,564 x 1.16—20,374 ft. sheathing, at $40	$ 814.96	
17,564 x .84—14,754 ft. studs and bracing at $35	516.49	
17,564 x .03—527 lb. wire, at $0.07	36.89	
17,564 x .005—88 lb. com. nails, at $0.06	5.28	
	$1,373.62	
Salvage on lumber, 60 per cent—21,000 feet at $25	525.00	
Net cost material	$ 848.62	$848.62

Labor

Approximately 35,000 ft. B.M. to erect and wreck

35,000 x .019—665 hr. carpenter, at $0.80	532.00	
35,000 x .005—175 hr. laborers, at $0.40	70.00	
35,000 x .012—420 hr. wrecking, at $0.40	168.00	
35,000 x .002— 70 hr. foreman at $1	70.00	840.00
		$1,688.00

Cost per sq. ft. at the above prices, approximately 9½ ct. sq. ft.

If there are pilasters in the above wall forms, use the constants given for pilasters, and add to the above labor hours.

—From "Engineering and Contracting"

Standardization of Lumber

A Movement to Define Clearer Grade Rules and Adapt Them to Consumption Needs—Need for Official Inspection

U. S. Secretary of Commerce Hoover in giving the lumber industry the vision of a standardization of nomenclature, grades, and guarantees, and of the benefits to accrue from a national agency for the administration, nationally and internationally, of an inspection service embracing all woods, has rendered it a service of inestimable value.

The accomplishment of a system of standard names, standard rules for the grading and inspection of lumber, and the adoption of effective means, such as grade-making the lumber, car cards, showing quantity and quality of the lumber and other means for assuring the integrity of grades and quality, and to prevent grade manipulation, would mark an epoch in the industry. If in addition, an independent, impartial agency, national in scope, undertook to supply everyone who desired it , an inspection service, at a reasonable cost, the industry would be approaching a plane of great improvement, and undoubtedly would command the public confidence in a way that has been lacking in the past.

Especially noticeable would be the improvement in respect to the hardwood industry, where because of the great variety of woods and consequently the multiplicity of grades, clarification and standardization is greatly needed; furthermore the internal dissensions regarding the control of inspection service have been such as to create doubt in the public mind as to the adequacy and integrity of the instrumentalities heretofore controlling the service. Certainly the refusal of the service except to members of the association supplying it, has been wrong and is indefensible.

Grade rules as they exist at the time Mr. Hoover makes his suggestions are certainly not, at least in the hardwood industry, such as to conduce to the most perfect utilization of the lumber. The best informed thought, practically and technically is practically unanimous in the view that the rules are of more or less haphazard growth, and are not the result either of scientific study or scientific formulation. They are not such as to scientifically conform production to consumption requirements.

The lack of scientific adaptation of grades to consumption needs often results in the consumers being burdened with a large amount of by-products or so-called waste material, for which he really has no use, but for which he must find one, or else the material becomes a total loss in his hands. Capable authorities estimate that the amount of such waste can, by the perfecting of the standardizations proposed, be reduced many per cent—estimates ranging variously from 60 to 70 per cent.

The universal approval among consumers of the proposals of the Secretary of Commerce is indicated by the following editorials from a representative trade publication serving the wood-working industry, in which it was said:

"The woes of the wood-worker have been largely due to a plethora of patterns, defective nomenclature, confusion in grades, etc. With his usual foresight and energy, Secretary Hoover has singled out this weak spot in the trade and begun remedial measures. The four-day preliminary conference of American lumbermen which he called reflects a unanimous opinion which will undoubtedly result in much standardization, in definite nomenclature, universal grades, markings and practices. It looks as though a national system of inspection and certification would be established, to embrace the entire trade, that descriptions of different species of lumber will be made as uniform as possible, that inspection service will be open to consumers in settlement of all disputes, and that this system will be extended to foreign consumers. It will certainly be a great satisfaction to the consuming trade when all sources of supply are governed by uniform rules and standardized grades protected by official and unprejudiced inspection."

Such a scientific adaptation of production to consumption requirements and a fuller understanding by consumption of the possibilities of supplying its needs will tend to a more perfect utilization of forest products, and not the least important of the consequences will be the resulting conservation of our timber resources.

Industrial Relations Problem

Really a "Human Relations" Problem —Responsibilities of the Employer and the Employee

Excerpt of an address by Ernest T. Trigg, president of the National Federation of Construction Industries

The whole question of "industrial relations" as we have come to call it,—is one of the most important and fundamental problems confronting the entire world to-day. I do believe that there are unmistakable signs indicating a better understanding of the situation and a clearer realization of the responsibilities on both sides than has heretofore existed. Really, the problem is one which I have always preferred to think of in terms of **"human relations"** rather than **"industrial relations,"** because it is essentially a matter of relationship between man and man,—a distinctly human proposition. The great economic loss which we are called upon to stand every year because of disputes between employers and employees, is a bill which the public, as an innocent bystander, has to pay. It does seem so utterly foolish and unnecessary and could so easily be avoided by a proper understanding between the employer and employee, of the problems, the viewpoints and the necessities of each by the other. The employer is, undoubtedly, the one who should assume the leadership of and keep the human touch with his own group of workmen. Unfortunately, all employers do not do so, and so long as they vacate this position, just so long will there be room for interference in their mutual affairs by third parties who so often are the root of the trouble. Employers are not entirely blameless in the situation; education of the employers as to their responsibilities and duties is, in my opinion, quite as essential as the education of the employees.

It is the employers' responsibility, for one thing, to see to it **that in times of depression, when there are fewer jobs than there are men, the wage of the workingman is not cut down below the living point,** on the other hand, **the employee should realize that there is a point over which the wage rate cannot successfully go if our industries are to continue to thrive and the wheels in our factories to go round.**

Let me take your minds, for a moment, back to the original thought that our various industries are producing quantities of certain products to be distributed to others, who in turn are producing other and different products. If the cost of producing in any one factory or group of factories, gets too far out of balance with economic levels in other industries, the inevitable result is a refusal to trade and the destruction of the market for that industry. Either that or the producers of other commodities bring their values up to an even basis and no one benefits. Take the case of the building trades; the high level of costs, not only of labor but of material, professional services and finances, is reflected in the rents which the workingmen themselves, as well as the rest of the public, are obliged to pay. Rent, more than any other item in the family budget, has so far stubbornly resisted the pressure for reduction. A large amount of the new building now going on is of homes, many of them of the workingman-type. This means that the investments made in these homes call for a continued high rental in order to yield a proper return, or else some day before long the investor, oftentimes the workingman himself, will be called upon to take a substantial deflation in his investment. Either proposition is bad for the welfare of our people as a whole. However, the revival which has taken place in the construction industry is, without a doubt, the backbone of a general business revival and should not be hampered or interfered with. The point I am making and the appeal which I would like to make to every one involved is **that runaway markets under the circumstances, either in the cost of materials or services, can only in the long run, have a reactionary effect which will be much more disastrous to the people as a whole than any temporary benefit there may seem to be in it.**

In this, the fourth year following the signing of the armistice, we still find ourselves confronted with many problems of readjustments; many things are still way out of gear. I do not feel, however, that there is anything in the situation to make us discouraged; on the contrary, I am impressed with the fact that not only our country, but the world as a whole, has made greater progress on the road to readjustment than might reasonably have been made in the same periods following previous wars. When we realize that the great World War shook the economic and social structure of the world to its very foundation, and that the problems resulting therefrom are much more far-reaching, serious and fundamental than those following any previous war, then we must appreciate that permanent readjustment can only come by slow but steady and sane processes. The greatest help which can be given to those in direct authority and who have the immediate responsibility for working out these problems is a reasonable, sane, constructive attitude on the part of all people. It is the time for this sort of helpfulness and for a display of unselfishness on the part of everyone, and especially on the part of the group we have come to term employer and employee, if we are to get back to a permanent, normal basis in the relatively near future. Returning to the building situation again, it seems to me what I have just said is especially true with it, as it exists to-day. Surely it is not fair that a condition should continue which makes for permanently high rents while other items entering into the family budget have already been substantially reduced and will, undoubtedly, be further cut down. It must be remembered that investment in home building is a permanent one, relatively speaking, and it seems to me that its present high basis is, therefore, much more serious to the public than if it applied to some consumables. In a sense, it is not so important if to-day we pay a relatively high price for a suit of clothes or for certain food products, because at best, their life is short and replacement may come at a lower level. An investment in a home, however, at the present levels, means a carrying charge or rental related to the high rate of investment, extending over a normal life-time.

Low Maintenance Cost for Streets

An astounding low cost of maintenance for paved streets is reported from Portland, Ore., where for the past three and one-half years the city, according to the annual report of the Board of Public Works, has had under maintenance 6,780,933 square feet of asphaltic concrete base and surface pavement. The total cost of maintenance for the three and one-half year period was only $558 or $.00008 per square foot.

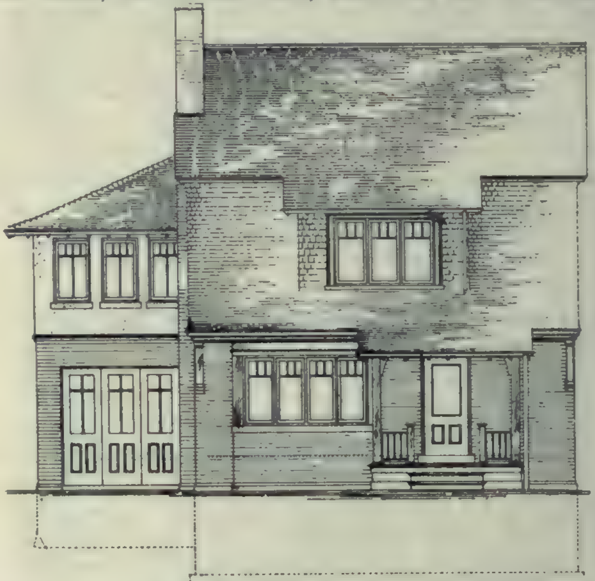
The Contract Record's

Weekly House Suggestion No. 31

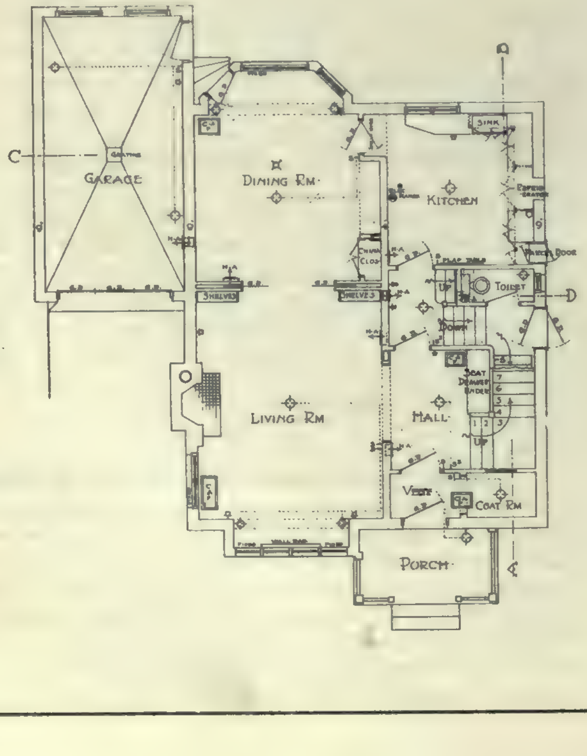
The house we are illustrating this week was designed recently by Messrs. Gordon & Helliwell, architects, of Toronto, and will shortly be constructed in that city. The general construction will be brick and stucco and the interior trim and floors will be of hardwood throughout. This is an excellent type of the square-plan residence and is especially replete with service details, as a glance at the reproduced floor plans will show. There will be a through hall to the kitchen, divided into two sections, the main staircase being located in the front section, which will also contain a built-in seat. The large living room is entered from the front hall through double doors. This room will contain a beautiful, square fire-place in the centre of the side wall and will also be furnished with built-in bookshelves on either side of the wide entrance to the dining room. The latter room will be conveniently accessible from the kitchen through a swinging door at the rear, as seen on plan herewith.

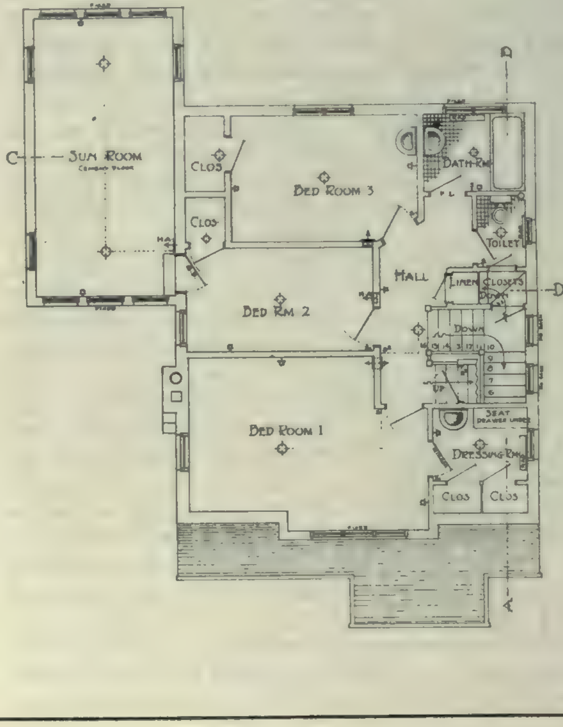
In the construction of better-class homes of the present day, many little time and labor saving features are being introduced in the kitchen arrangement, and in this particular residence will be incorporated several of these modern service features. As seen on the plan, there is a built-in refrigerator, with provision for icing from the outside; a receptacle for parcels, which also may be opened from the outside; a built-in flap table, which is a handy feature and one that takes up very little room when not in use; besides the customary cupboards; shelves, etc. In the rear section of the hall will be located the entrance to cellar stairway and a rear staircase to the second floor. There will be a toilet on the landing of the cellar stairs, as seen on plan and also an entrance from the side on this landing.

The second floor will contain three large bedrooms, small dressing room, sun room over the garage, bathroom and separate toilet. Hardwood trim and flooring will be used throughout this floor also, with the exception of the bathroom and toilet, which will have white tile floors, and the sun room, which will have a cement floor. The small dressing room, to be situated within the large front bedroom, will be equipped with built-in seat, wash basin and will contain large bevelled mirror in the door.



There will be a full sized basement under the house, divided into boiler room, laundry, larder and coal bin.





Carborundum is Starred in Movie

A motion picture adventure is in store for non-theatrical audiences in "The Jewels of Industry," the eight-reel educational film of the Carborundum Company.

The picture shows how Carborundum is produced at the temperature of 4,000 deg. Fahrenheit—a far greater heat than is necessary to vaporize steel. The film visualizes, step by step, the various processes by which the crude Carborundum is converted into grinding wheels and other forms of abrasives to meet the needs of industry.

But this movie is more than the story of Carborundum. It is virtually a survey of American Industry. In preducing the picture for the Carborundum Company the Rothacker Film Company sent cameramen to 58 different industries to obtain scenes picturizing Carborundum on the job in its various uses. One motion picture trade journal says the Carborundum film marks a milestone in practical picture production, asserting that it is the most comprehensive industrial picture ever filmed. The critic said, "Show this film abroad and the eyes of the world behold America's industries in an hour and thirty miutes."

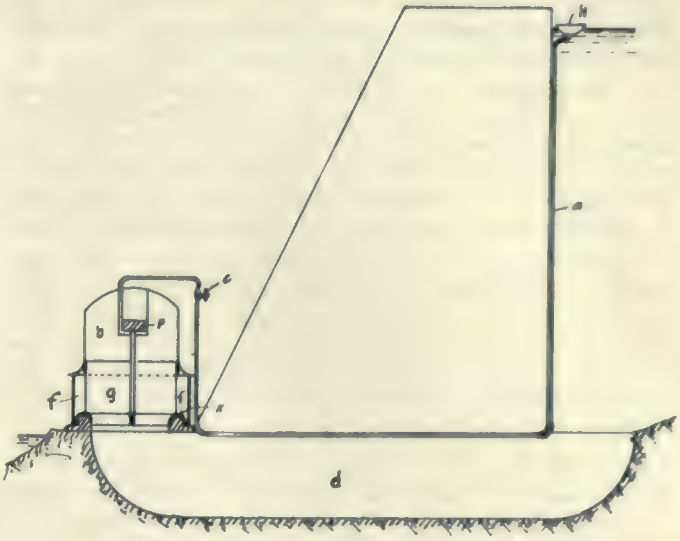
While "The Jewels of Industry" in its entirety is eight reels, or 8,000 feet, has been broken up into units to fit various lengths of programs and to present the features that would prove most interesting to different audiences.

The picture has been given extensive circulation by the United States Bureau of Mines which loans films to a large number of schools and universities.

The picture thus far has proven a splendid medium because of its educational value and because it has a decided advertising asset, and it will continue to pay dividends. It is at present available to manufacturers who wish to stage an interesting cinema program to show their employees how the Carborundum products with which they work are made and how the other fellow uses these abrasives in other plants under widely varied conditions. It will be loaned without charge to schools, clubs, churches, or other substantial organizations.

Automatic Regulation of Water Level

The following is a description of an apparatus intended for the automatic regulation of water level. It comprises a stationary bell or inverted cup (b) placed some distance above the plane of the outlet of a conduit (d) running through the base of the dam. An annular closer (g) is made to slide vertically into the cup and to tightly fit an annular seat (k) on the conduit. The closer is connected to a piston (p) operating into a cylinder secured to the roof of the bell. A tube (a), having at its upper end, that is, at the upper water level a funnel (h) of a diameter substantially larger than that of the tube, is placed along the front face of the dam and through the conduit and arranged as shown to supply the necessary water pressure under the piston. As soon as the level of the water rises above the funnel, the water entering the tube and under the piston causes the same to rise, thereby lifting the closer and allowing the upper water to flow freely through the conduit at (f) to the lower level. A small cock (c) is placed on the tube near the bell, the purpose of which is to allow the water contained in the tube to run out and relieve the pressure from the piston when the water level above the dam has lowered below the level of the funnel, the closer then dropping by gravity and again closing the conduit. The new apparatus is patented in Canada.



Device for regulating water level behind a dam

Mainly Constructional

East and West—From Coast to Coast

The interior brickwork which had lined the stone walls of Montreal's former city hall, was sold second-hand at the rate of ten dollars a thousand.

A new road will shortly be built from Jonquieres to Chicoutimi, in the northern part of Quebec. The two municipalities will pay the costs equally.

The government grain elevator at Port Colborne will be enlarged. The present capacity of two million bushels will be increased to at least three millions.

The contract for a new bridge over the Ganeraska near Port Hope, Ont., has been awarded to Alex. Christie and Son of Ottawa. The bridge will be a concrete structure with an 80-foot span and 23 feet wide.

A petition has recently been circulated in Hensall, Ont., asking the council to obtain tenders for paving Main street, and as the necessary number of signatures of property holders has been secured, the paving may be looked upon as assured.

The construction of a roadway on the Quebec bridge will be urged shortly, according to reliable information. It is stated authoritatively that when the bridge was built, ample provision was made in its design for the addition of a roadway in the centre of the bridge.

In operation but a few months, the Hamilton, Ont., plant of the Libbey-Owens Sheet Glass Company, Limited, which represents an investment of two million dollars, will be doubled in the near future as increased business justifies such an expansion, officials stated recently.

Tenders will be opened shortly for the construction of a new cement concrete bridge over Maxwell's Creek on the North Gravel Road, near Owen Sound, Ont. The shoulders at either side of the cement strip on this road are being built up with macadam, and this will soon be completed.

J. P. Hynes, president of the Ontario Association of Architects, conferred recently with members of the Hamilton chapter, in reference to the convention of architects of Ontario, which is to be held in Hamilton on September 15 and 16. It is understood that arrangements are now practically completed for this meeting.

Building activity in Quebec has established a local record. During July, 119 permits, representing a value of $958,745 were issued by the Municipal Department of Public Works. The month of May last year was considered a record breaking one for construction, but the total value of permits issued that month was $30,000 less than July of this year.

The erection of a six-room extension to the Alexandra School is now under consideration by the Waterloo, Ont., School Board. The proposed extension would serve as a technical school. The board announces, however, that in the proposed plans it has no intention of competing with the Technical School at present being erected by the Kitchener-Waterloo Collegiate Board.

The Montreal city council recently adopted the report of the executive committee of the city council instructing Mr. Louis Parant, the city architect, to prepare and submit plans for the proposed new city hall. The report further proposed that the new structure should be built in such a manner as to make use of the standing walls of the building destroyed by fire in March last.

Five hundred trade union delegates from all parts of Canada, together with a delegate from Great Britian and one from the United States, will attend the 38th annual convention of the Trades and Labor Congress of Canada, which opens in Montreal on August 21. The question of arbitration in labor disputes affecting industries and public utilities will be one of the most important matters discussed.

Realty activity in connection with the development of several new tracts, at Bridgeburg, Ont., is under way. A large section of the Barrett Estate, which has been held by its Toronto owners for some time without being broken up, has been purchased, and one owner will build six houses thereon immediately. It is also planned to cut up in the near future the big Anderson Estate just recently sold.

A recommendation that Works Commissioner Harris be given all contracts save one for the work of paving upper Yonge Street, Toronto, Ont., was sent on to the City Council recently by the Board of Control. The total cost of the work will be $472,510, and the sole stretch involved on which the Works Commissioner was not the lowest tenderer, was from Summerhill to Farnham Aveues. This piece the Grant Contracting Company secured by a bid of $20,290.

The Canadian National Parks Branch of the Department of the Interior has organized a competition among the archtects and art schools of Canada for a design for a suitable standard to which will be affixed the bronze tablet intended to mark the historic sites of the Dominion which are judged by the Historic Sites and Monuments Board of Canada to be of national importance and worthy of preservation and commemoration.

Chief Engineer Vallee, of the Public Works Department, Quebec, announced recently that the East Angus Bridge, on the St. Francis River, which has cost $200,000, would be opened to traffic by the 15th of August. The bridge is a double-deck one and already the lower-deck has been in use for a few days. Information given out also was to the effect that sixty bridges were being built under the supervision of the Government, fifty recently having been completed.

A permit will be shortly taken out for another modern store and office building in the vicinity of Robson Street, Vancouver, B. C. A deal was recently consummated whereby the title to the 50 by 120-foot lot adjoining P. Burns & Co.'s store on Granville Street, just opposite the Capitol Theatre, changed hands from the ownership of Mr. T. H. Hazlett of the Mission Confectionery Co., Ltd., to that of Mr. J. J. Coughlan, at a price understood to approximate $100,000.

Several frame structures are being built in different open spaces in Chatham, Ont., and will be used for demonstration purposes during the annual convention of the Dominion fire chiefs, which will be held on the last four days of August. One of the buildings will be covered with a fireproof composition, and the Dominion's fire chiefs will endeavor to burn this building to the ground. Another building in course of construction will be used to demonstrate a new sprinkler system.

Three hundred men employed at the shipbuilding plant of the Fraser Brace Company, Three Rivers, Que., quit work recently on the ground that they had not received their semi-monthly pay cheques. The company officials explained that the cheques are expected to arrive on the 8th and 23rd of each month but were late in coming. The men were paid by cheques drawn on a local bank, but they refused to work until the assurance was given them that they will be paid regularly from now on.

Building permits in Windsor, Ont., for the month of July totalled $325,985 according to a report issued by Building Inspector Robert Parker. One hundred and twenty permits were issued. For the same period last year the permits totalled $448,175. For the first seven months of 1922, 800 permits have been issued representing an expenditure of $2,800,195. This is a slight decrease over that of the same period in 1921 when the total was $3,736,570. This included, however, a permit of $1,215,000 for the Prince Edward Hotel.

Legislation for the establishment of iron and steel works in British Columbia will be put through at the next session of the Legislature according to a recent announcement which was made, following a Cabinet meeting, to representatives of the Coast Range Steel Company, a $15,000,000 corporation organized a year ago under H. J. Landahl. Under plans which have been discussed by the steel people with the British Columbia Government and the Facilities Committee of the Imperial Board of Trade, the total investment in the plant will run to $12,000,000.

In St. John, N. B., the total etimated cost of bulidings for which permits were issued by the building inspector for the past month, is far in excess of the total for July, 1921, according to figures given out by the building inspector. The total value of permits for the year to date is also greatly in excess of the total for the corresponding period in 1921. In July, 1922, the value of new buildings was estimated at $180,600, while in July, 1921, the total was $48,500. For this year to date the total value of new buildings is $475,600, compared with a total for last year to the end of July of $148,700.

At the meeting of the city council of Westmount, P. Q., recently, the chairman of the building committee, Ald. A. L. Robertson, submitted a list of the contractors' tenders for the construction of the new city hall, stating that the lowest tender was submitted by the Nicholson Constructions Limited, the amount of which was $127,953. In addition to this amount there would be items of architects' fees, superintendence, and hardware, etc., which would, on prices received, bring the total cost up to $138,000. On the understanding, therefore, that the said total cost shall not exceed $140,000 he moved a resolution accepting this tender, which was adopted.

Following the death of a workman who was killed on the morning of August 5, when he was struck by a falling boom of a derrick on the roof of a new building at Bay and Temperance Streets, Toronto, Ont., Coroner M. M. Crawford recommended that the authorities appoint inspectors for all derricks and elevators used in building construction. It was brought out at the inquest that Griffin's death was due to the breaking of a defective wire cable which held the boom, hitting him on the head and the jurors were of the opinion that the accident might have been avoided had proper care been taken of the cable which was rusted badly. The boom snapped on striking the building and fell to the ground.

The city council of Winnipeg, Man., is looking with favorable eyes toward a venture in central heating which will be adapted to the needs of the prairie city. At a meeting of the city council recently, W. E. Skinner, of Minneapolis, was appointed at a retaining fee to make a full report on the feasibility of establishing a central steam heating plant in connection with the proposed standby in Victoria park for the Hydro Electric system. Mayor Fowler explained that Mr. Skinner had been granted a franchise some years ago to install a steam heating plant and had a great deal of data available which the city would require several months to obtain. Members of council thought it would be well to have a report on the proposed scheme and voted for his appointment without discussing the principle of installing the plant at the present time.

Chief Engineer Alex. Grant reported recently that construction on the various sections of the new Welland ship canal was now in full swing and would continue until late in the autumn. On sections 3 and 4, recently taken over by the Lyall Construction Company, there were 550 men employed, with the prospect of this number being increased. It is planned to lay 2,000 cubic yards of concrete daily at lock six, while three steel towers will be put in operation on the concrete work. Delivery of sand is being made at Port Weller, and brought up to Thorold on the construction railway. The Canadian Dredging Company has four dredges at work on section five, where 250 men are employed. Porter Bros. have 1,000 men at work, and have just completed four concrete cribs, one of which will be sunk this week. Considerable concrete work is under way.

Salvaging equipment, was recently dispatched from Kingston, Ont., by the Donnelly Salvaging and Wrecking Co., for the purpose of releasing the Rapids Prince from its position in the Lachine Rapids. In view of the heavy current running on both sides of this place, it may be found unpracticable to use anything but hand-power to draw the ship off the rocks. If possible, a gasoline-driven winch will be taken to the island. If this is found impossible, a capstan will be securely bolted to the bed-rock of the island and mechanical devices will be used to multiply the hand-power applied. Following recommendations of the salvagers, the forepeak and amidships section of the hull have been flooded in order to reduce the likelihood of any unexpected release through the increase in flow of water in the rapids. Such a release might result in the ship drifting into a more dangerous position.

The field house which is to be built for McGill University, Montreal, P. Q., adjoining the Molson Stadium will cost approximately $32,000 when completed and equipped, according to an announcement made by the secretary and bursar, A. P. S. Glassco. The contract for the erection has been let to the firm which submitted the lowest tender, D. G. Loomis & Sons. The building will be completed and equipped early in the autumn. Tenders will be asked for the new gymnasium about August 25. Tenders for the new pathological building, which is to be built between the Royal Victoria Hospital and the Molson Stadium, will also be asked for during August. The foundations for this building are completed. Foundations for the new mining-geological building will be started this fall, but the erection will not be begun until early in 1923. The extension to the power station will be undertaken as soon as the new buildings are sufficiently advanced to demand more power than produced at present.

To prevent flooding of Trent Street property, No. 2 committee of London, Ont., city council has recommended that an embankment of earth and cinders be placed on the south bank of the River Thames, provided that the citizens involved will deed a site to the city for this purpose. Led by A. R. Douglas, their solicitor, several Front Street ratepayers were present at the meeting to hear the report of city engineer H. A. Brazier on the estimated cost of a cement breakwater on the river bank to protect their property. The engineer reported that a breakwater similar to that constructed for the protection of London West property, 1,600 feet in length, would cost $52,800. The engineer declared that $52,800 was the lowest quotation possible for a permanent breakwater, and pointed out that the assessed value of the property to be protected totalled approximately $23,000. As this price is prohibitive, and in the opinion of the meeting, would not be tolerated by the electors of the entire city, the committee finally decided to urge that an embankment be built on the river bank, provided that land for the purpose is deeded to the city.

Considerable economy in expenditure has already been effected by the director of public works of the city of Montreal, Mr. H. A. Terreault, and one such economy has added more than $100,000 to the amount available for expenditure and in another instance has added $35,000 to the amount available for the maintenance of sewers. The big economy was effected at the low level pumping station by the simple expedient of rigging a motor to a pump formerly operated by steam power. While the actual pumping is done by electric power, it is necessary to have a reserve. For that purpose steam was maintained in the boilers at the power plant so that in case of a shut-down by an electrically driven pump, a steam pump might be brought into operation. The director coupled up a motor to a 30,000,000 gallon pump and this at once obviated the use of the steam plant. The coal bill alone for this plant represented an annual expenditure of $58,000, while labor added another considerable amount. The low level station is now in a position to take care of the daily pumping operations in a more economical manner, and the money saved may be spent in other necessary works.

Personal

Mr. T. S. Scott, Kingston, Ont., was recently appointed city engineer of Niagara Falls, Ont., at a salary of $3,600 a year, in succession to J. C. Gardner.

Mr. T. D. Mylrea, for the past two years in the employ of Messrs. Norman McLeod, Limited, engineers, Toronto, Ont., and formerly of the city architect's department, has recently been appointed assistant professor of structural engineering at Illinois University.

Trade Incorporations

The Ontario Gazette announces the incorporation of the Moore Construction Co., Limited, with a capitalization of $50,000. The new firm is licensed to carry on the business of building contractors, etc. Head office, Windsor, Ont.

The Ontario Gazette announces the incorporation of Joyce Brothers, Limited, with a capitalization of $45,000. The new firm is licensed to carry on the business of structural, civil and mechanical engineers, builders, etc. Head office Bronte, Ont.

Fire destroyed the plant of the Canadian Pipe Co., at Vancouver recently, resulting in damage estimated at $100,000, partly covered by insurance. The cause of the fire is unknown.

CONSTRUCTIONAL ACTIVITY

Period of August 9 to August 15, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Acton Vale, Que.
J. C. St. Pierre, secy., has plans and will receive tenders until Aug. 30th for construction of mechanical filtration plant for Town. Plans also with M. S. Ouimet, 76 St. Gabriel St., Montreal.

Bagotville, Que.
Plans are drawn for waterworks and sewerage extension to cost $8,000 for Town. J. F. Grenon, Engr., Chicoutimi.

Levis, Que.
Plans are drawn for concrete pavement to cost $50,000 for City. J. A. Lefebvre, Engr., Parliament Bldgs., Quebec.

London, Ont.
City Council plan construction of storm sewer in Central Ave. area. H. A. Brazier, City Engr.

Ottawa, Ont.
City Council plan construction of Tarvia macadam pavement on Centre St. A. F. Macaullum, Commr. of Works.

Penetanguishene, Ont.
James, Proctor & Redfern Ltd., Engrs., 36 Toronto St., Toronto, have plans and will receive tenders until Aug. 21st for construction of reinforced concrete pavement on Main St. for Town.

Walkerville, Ont.
H. W. Patterson, Engr., has plans and will receive tenders until Aug. 23rd for construction of pavement for Town.

Whitby, Ont.
James, Proctor & Redfern Ltd., Engrs,. 36 Toronto St., Toronto, have plans and will receive tenders until Aug. 25th for construction of bitulithic pavement to cost $50,000 for Town.

CONTRACTS AWARDED

Grimsby, Ont.
General contract for Warrenite Bitulithic pavement for Town is awarded to Warren Bituminous Paving Co. of Ontario Ltd., 54 University Ave., Toronto.

General contract for asphalt pavement costing $71,000 for Town is awarded to Auto Road Construction Co. Ltd., 29 Erie Ave., Niagara Falls. F. N. Rutherford, Engr., St. Catharines.

Hensall, Ont.
General contract for concrete pavement costing $30,000 for Town is awarded to Hamilton Contracting Co., Home Bank Bldg., Hamilton. Roy Patterson, Engr., Goderich.

Jonquires, Que.
Contracts for pipe and special fittings required for sewerage system extension costing $25,000 for Town are awarded to Canada Foundries Ltd., St. Maurice St., Three Rivers, and Terreau & Racine, 196 St. Paul St., Quebec. J. F. Grenon, Engr., Chicoutimi.

Moose Jaw, Sask.
Robert Kjarsgaard, Moose Jaw, has general contract for construction of concrete sidewalks costing $7,000 for City.

Oakville, Ont.
General contract for macadam and Tarvia roads costing $25,000 for Town is awarded to Lumsden Engineering & Transport Co., 10 Lumsden Bldg., Toronto. Jas. A. Bell & Son, Engrs., St. Thomas.

Town Council awarded contracts for pavements, and curbs and gutters, costing $46,000 to King Construction Co., Oakville, and Jas. Gibson, Oakville. Jas. A. Bell & Son, Engrs., St. Thomas.

Owen Sound, Ont.
General contract for construction of concrete sidewalks costing $11,000 for City is awarded to H. G. Weston, Simcoe, Ont. D. J. Fleming, Engr.

Thorold, Ont.
General contract for pavement on Ormond St. for Town is awarded to Auto Road Construction Co. Ltd., Niagara Falls, Ont. F. N. Rutherford, Engr., Queen St., St. Catharines.

Three Rivers, Que.
General contract for construction of concrete sidewalks costing $18,000 for City is awarded to Donat Blanchette. Chs. Gelinas, Engr.

Toronto, Ont.
contract at $20,290 for pavement on Yonge St. from Summerhill Ave, to Farnham Ave. for City is awarded to Grant Contracting Co., 50 Front St. E. All other paving work on Yonge St. by day labor by Commr. of Works.

General contract for laying water pipes, etc., at cost of $9,451 for City is awarded to Grant Contracting Co. Ltd., 50 Front St. E.

City Council awarded following contracts: Sewers, at $99,600, Roger Miller & Sons, Lumsden Bldg.; Sewers. $16,352, Jeron & Angotti, 90 Curzon St.; sewers, $42,487, W. E. Taylor, 22 Falcon St.; sewers, J. H. McKnight Construction Co., 88 St. David St.; sewers, Grant Contracting Co., 50 Front St. E.; water pipes, 24" at $107.25 per length and 36" at $196 per length, National Iron Corp. Ltd., Cherry St.

Trafalgar Twp., Ont.
Contract for concrete pavement costing $25,000 for Twp. Council is awarded to Thornton & MacNamara, Bronte, Ont. Roy F. Smith, Engr., Dundas St., Oakville.

York Twp., Ont.
Twp. Council awarded following contracts for sidewalks and pavements: Kilmer & Barber, 24 Adelaide W., Toronto; Constructing & Paving Co., Confederation Life Bldg., Toronto; L. Simpson, c/o F. Barber, Engr., 40 Jarvis St., Toronto; P. Licastro, 1423 Dufferin St., Toronto.

Contracts for 6" watermains costing $30,000 for Twp. Council are awarded to W. E. Taylor, 22 Falcon St., Toronto, Ruscica Bros., 256 Ontario St., Toronto, and A. Cavotti, 257 Euclid Ave., Toronto. F. Barber, Engr., 40 Jarvis St.

Railroads, Bridges and Wharves

Canso, N. B.
R. C. Desrochers, secy. Dep't. Pub. Works, Dom. Gov't., Ottawa, will receive tenders until Aug. 24th for construction of wharf. Plans with Dep't. and office of Dist. Engr., Halifax, and post offices, Canso and Antigonish, N. S. Accepted cheque for 10% of tender required.

Chambly, Que.
J. L. Boulanger, Min. Dep't. Pub. Works, Prov. Gov't., will receive tenders until Aug. 30th for construction of reinforced concrete bridge between Chambly Twp. and Chambly Basin.

La Malbaie, Que.
R. C. Desrochers, secy. Pub. Works Dep't., Dom. Gov't., Ottawa, will receive tenders until Aug. 23rd for construction of wharf. Plans with Dep't., Dist. Engrs., Post Office Bldg., Quebec, Shaughnessy Bldg., Montreal, and Post Office, La Malbaie, Accepted cheque for 10% of tender required.

London, Ont.
Grand Trunk Rly. contemplate installation of interlocking signal system to cost $15,000.

Moncton, N. B.
J. W. Fraser, architect, 132 Steadman St., has plans and will receive tenders, no closing date set, for erection of car barn for Moncton Tramways Electricity & Gas Co., 38 Mechanic St.

Port Hood, N. S.
R. C. Desrochers, secy. Dep't. Pub. Works, Dom. Gov't., Ottawa, will receive tenders until Ang. 24th for repairs to wharf. Plans with Dep't. and offices of Dist. Engrs., Halifax and at Post Office, Port Hood, N. S. Accepted cheque for 10% of tender required.

St. Sauveur, Que.
J. L. Boulanger, Min. Pub. Works, Prov. Gov't., Quebec, will receive tenders until Aug. 30th for construction of bridges.

Trois Pistoles, Que.
J. A. Levesque, secy. Town Council, has plans and will receive tenders, no closing date set, for construction of steel bridge. Plans with I. E. Vallee, Engr., Parliament Bldgs., Quebec.

CONTRACTS AWARDED

Arran Twp., Ont.
W. G. Moore, Allenford, has general contract for erection of concrete bridge for Twp. Council.

Bentinck Twp., Ont.
Contract for construction of bridges for Grey County Council is awarded to

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications LIMITED

THOMAS S. YOUNG, Managing Director

HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U.S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, August 23, 1922 No. 34

Iron and Steel Industry for British Columbia

One of the most important developments in the present period of returning activity is the definite assurance which is now forthcoming that within a short period blast furnaces will have been equipped and in operation on the Pacific Coast, capable of turning out 500 tons of pig iron daily.

The proposals which have now come to so satisfactory a stage emanate from the very highest sources, three of the most influential of the British firms in the industry being concerned in the project. These are Vickers Ltd., the largest steel manufacturers of the Empire; Simon Carves, Ltd., well-known builders of blast furnaces and coke oven plants, who will have charge of the design and equipment of the plant; and the Wellman, Smith, Owen Engineering Company, great builders of open hearth and rolling mills, who will later have charge of the equipment of steel mills when the preliminary iron plant is in operation.

The new concern, known as the Coast Range Steel Company, of Vancouver, has been quietly working on the negotiations for some years past, but the first public announcement was reserved until the present definite assurance of actual construction in the immediate future could be made. It is understood that the three British firms mentioned are prepared to invest the necessary funds for the undertaking, which may reach a total of £30,000,000 and that the actual availability of the money was conditioned on the obtaining of guarantee support from the Imperial, Dominion and provincial governments.

This support has been granted by the Imperial government under the Trade Facilities Act to an extent of one-third of the proposed preliminary issue of $10,500,000, and assurances have been received from the Dominion government that similar assistance will be granted. The provincial government has promised its support, and following a meeting with the representatives of the company and of various public bodies interested in the development, the Premier issued the official statement which follows:

Government's Official Statement

"That the government would be prepared at the next session to submit legislation which would make the iron ore bodies in the province available for use either on a percentage, tonnage or royalty basis.

"That the present legislation for a bounty on pig iron produced in British Columbia would be repealed.

"That the government would promote legislation authorizing a guarantee of the company's bonds to the extent of one-third the amount required to establish an iron smelting plant for the production of pig iron in British Columba.

"This guarantee would be conditioned upon each of the Dominion government and the Imperial Trades Facilities committee guaranteeing the other two-thirds of the capital required.

"Further conditioned upon a thorough investigation covering raw materials, plans, specifications, locations, contracts conduct, management, financing of the company and probabilities of success satisfactory to the government.

"The government of the province to have security for its guarantee ranking equal with the security of the Dominion and the facilities committee, the same being a first mortgage upon all the assets of the company.

"Further conditioned that the authorized capital, the subscribed capital and the paid up capital shares of the company be satisfactory to the government, the undertaking being that if the operation of the blast furnace to be established was fully satisfactory the before mentioned guarantee would be extended to include the establishment of a steel producing plant and also rolling mills, the whole of the guarantee of the province, which would be proportionately divided according to the work undertaken not to exceed £800,000 sterling, or its equivalent in Canadian dollars.

"The minister of mines was authorized to confer with the Dominion authorities and with the facilities committee of the Imperial Board of Trade and to employ such expert officers as would be found necessary to investigate thoroughly every detail of the proposal, the government being determined that so far as humanly possible both the government and the investing public would be fully protected."

Apropos of the suggestion to be inferred from mention of the investing public in the final clause of the government's statement, it may be said that from opinions gathered on the coast it is not considered likely that any shares of the company will be available on the local market.

New buildings costing $1,500,000 will be opened by the Canadian National Exhibition this year, including the Coliseum and the Pure Food building.

Estimating the Cost of Brickwork

How a Bid Should Be Computed—The Factors Involved in Brick Laying—Data Covering Labor Operations—Why Brickwork Material Estimates Vary

By CHAS F. DINGMAN M.Am. Soc. C.E.

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Several years ago a builders' supply dealer issued a catalogue, including in it, some tables of valuable information, among which was one giving the amount of materials required to make the necessary mortar to lay one thousand bricks. For a mixture of one part cement, one part lime putty and three parts sand, the catalogue gave the quantities as 0.36 bbl. lime, 0.75 bbl. cement, and 0.32 yd. sand, 5/8 inch mortar joints were the basis for these figures.

As I was, and still am ,keenly interested in the cost of birckwork, I compared the table with the actual results reported from jobs upon which similar mortar and width of joint has been specified and found that the quantities used were as follows:—

	Job 1.	Job 2.	Job 3.	Job 4.
Bbl. lime	0.94	0.65	0.50	0.81
Bbl. cement	0.53	0.57	0.37	0.19
Yards sand	0.43	0.55	0.47	0.47

It will be noticed that none of the jobs completed furnished a very good check upon the figures given in the catalogue.

The small quantity of cement used on job No 4. is explained by the use of a local grey lime, rich in aiumina, which produces a very strong mortar even when the major portion of the specified quantity of cement is replaced by lime.

The variation in the amount of lime used on the other three jobs is probably explained by the difference in the "bulking" capacities of the different brands of lime used. For instance, three different brands show a production of putty of 2.50, 2.62 and 2.75 times the amount of dry lump lime and authorities writing on the subject give an even wider variation. From the above, it would seem that, to get the actual proportions called for in the specifications, the quantity of dry lime used should never be more than 40% of the quantity of cement used. However, we all know that the tendency is to greatly exceed the special amount of lime whenever possible because it produces a smoother working mortar which means a saving in labor cost of bricklaying even though the cost per cubic yard of mortar may be slightly increased.

Sand Governs Quantity of Mortar

Regardless of the amount of the cementing materials used, the quantity of sand used is what determines the quantity of mortar produced and the figures indicate a variation of practically twenty-eight per cent. between job No. 1 and job No. 2. Put in other figures, job No. 1 used 400 cubic inches of sand per cubic foot of wall, while job No. 2 used 510 cubic inches of sand per cubic foot of wall.

If the sand contained 33% of voids, three cubic feet of sand and one cubic foot of cement should produce three cubic feet of mortar even if no lime were used; but, as the sand usually used will average from 40% to 50% of voids, the addition of a cubic foot of lime putty cannot increase the total volume beyond 3.70 to 3.80 cubic feet. In other words, the total volume of mortar cannot be over 1.27 times the amount of sand purchased. In actual practice, because of waste and other losses, the total quantity of mortar produced is very likely to be slightly less than the total amount of sand purchased.

So far all of our figuring has been upon the basis of twenty-one bricks per cubic foot. This means that the brick size must not be over 63.24 cu. in. to get the result obtained on job No. 1 and 58 cu. in. to get the result obtained on job No. 2, and this brings us to one of the great reasons why brickwork estimates vary and, incidentally, why final results don't always check out with the estimate.

Bricks Vary Widely

In actual practice, we find estimators using an arbitrary figure for the number of bricks per cubic foot and that figure will range all the way from eighteen to twenty-one and a half, and because they seldom know in advance what brick will be used, they figure almost every job on the same basis of the number of bricks per cubic foot. This means that even if two men figured upon the same number of cubic feet of brickwork in a building, one might figure that he needed one hundred thousand brick and the other might figure on one hundred and twenty-five thousand, while the final quantities of brick and mortar materials bought for the job might not check either one.

So much for the quantity of bricks themselves. The cost of the mortar materials is a very large factor in the cost of brickwork and may require from one-fourth to nearly one-half of the cost of the bricks. If the quantity of mortar required could be accurately figured it should not be very difficult to determine the amounts of the ingredients and their costs. But since the size of bricks is not known in advance, the exact amount of mortar required cannot be known in advance either, so common practice is to use an arbitrary figure per thousand brick for each of the ingredients and these arbitrary figures vary all the way from those quoted in the first paragraph of this article to those given in the "Building Estimators' Handbook," which are: Lime, 0.87 ½ bbl; cement, 1.25 to 1.50 bbl; Sand, .50 to 0.625 cu. yd. for the same kind of mortar. At to-day's prices, the mortar first mentioned would cost just about one-half as much per thousand brick as would that given in the "Handbook." Mathematical analysis would seem to indicate that the first formula does not call for sufficient mortar to lay the bricks and that none of the four jobs reported used enough cement to produce the specified proportions and the figures in the "Handbook" are on the side of safety since they would produce slightly more mortar than required for most sizes of bricks.

Effect of Wall Thickness

Even if the amount of mortar per thousand brick were determined accurately for a given size of bricks, it would only be absolutely accurate for a given thickness of wall. For instance, if a thousand bricks laid in a 12-inch wall required 0.55 cubic yard of mortar, varying the thickness of wall would affect the quantity of mortar approximately as follows:—

8 inch wall	94%	0.51	cubic yards
12 inch wall	100%	0.55	cubic yards
16 inch wall	103%	0.565	cubic yards
20 inch wall	105%	0.58	cubic yards
24 inch wall	107%	0.59	cubic yards

These differences are small, it is true, and on a small building would average up so as to balance one another but, if costs were reported for a job having all 12-inch walls and those costs were used for estimating another one having all 24-inch walls, the difference might be appreciable. If a cubic yard of mortar costs twelve dollars, then the mortar for a thousand bricks in a 12-inch wall would cost $6.60 and in a 24-inch wall it would cost $7.08. On a million bricks the difference would be $480.00, well worth taking into consideration.

I have attempted in the discussion to show how such an apparently simple item in the estimate as brickwork materials warrants a great deal more of consideration and duty than is usually possible in the limited time allowed for preparing an estimate and submitting bids.

The accompanying tables will be found helpful in estimating the quantities of materials required to make a cubic yard of lime-putty, cement and sand mortar and to compute the cost of mortar per one thousand bricks, the size of bricks and width of joints being known. Having determined the cost of a cubic yard of mortar and the quantity required, the cost of mortar per thousand bricks is readily ascertained.

Quantity of Ingredients per Cubic Yard of Mortar

(In the proportions column, cement is given first, lime-putty second and sand third.

Proportions	Bbls. Cement	Bbls of Dry Lump Lime 180 lb. basis.	280 lb. basis	Loose Sand Cu. Yds.
1-1-3	2.28	1.21	0.82	0.94
1-1-2	3.02	1.58	1.07	0.91
1-1 ½-3	2.28	0.61	0.41	0,94
1-1 ½-2	3.02	0.80	0.54	0.91
½-1-3	1.19	3.12	2.11	1.00
½-1-2	1.76	4.61	3.11	0.99
1-3 with 10% lime-putty	2.28	0.13	0.08	0.94
½ with 10% lime-putty	3,02	0.17	0.12	0.91

Number of Bricks Required to Lay One Cubic Foot of Wall

Average Volume of One Brick in Cu. In	¼" Joint.	5/16" Joint.	⅜" Joint.	½" Joint.
60	23.7	22.4	21.1	18.6
61	23.5	22.1	20.8	18.4
62	23.3	21.9	20.4	18.2
63	23.0	21.7	20.0	18.0
64	22.4	21.3	19.9	17.8
65	22.2	21.1	19.8	17.6
66	21.9	20.8	19.6	17.4
67	21.6	20.6	19.3	17.2
68	21.3	20.3	18.0	17.0
69	20.9	20.0	19.8	16.8
70	20.6	19.7	18.6	16.6
71	20.5	19.5	18.5	16.4
72	20.3	19.2	18.2	16.2
73	20.0	18.9	17.9	16.0
74	19.8	18.7	17.7	15.8
75	19.5	18.4	17.5	15.6
76	19.1	18.2	17.3	15.4

If all vertical spaces are filled solid with mortar, the quantities below must be increased twenty-five per cent.

Volume of Mortar in Cubic Yards, Required to Lay One Thousand Bricks

(12 in. wall basis vertical spaces open)

Average Volume of One Brick in Cu. In	¼" Joint.	5/16" Joint.	⅜" Joint	½" Joint
60	0,28	0.35	0.42	0.56
61	0.28	0.34	0.41	0.55
62	0.27	0.33	0.40	0.53
63	0.26	0.33	0.39	0.52
64	0.29	0.35	0.41	0.57
65	0.28	0.35	0.41	0.55
66	0,28	0.35	0.41	0.55
67	0.26	0.33	0.39	0.52
68	0.31	0.35	0.42	0.61
69	0.30	0.37	0.43	0.59
70	0.28	0.35	0.42	0.56
71	0.29	0.36	0.43	0.57
72	0,28	0.35	0.42	0.56
73	0.29	0.36	0.43	0.57
74	0.29	0.36	0.43	0.57
75	0.30	0.37	0.45	0.58
76	0.31	0.39	0.46	0.60

None of these tables has been carried beyond the second place of decimals. I do not believe that the accuracy attained in scaling plans and computing quantities, or the accuracy attainable in measuring materials on construction work will warrant any greater refinement.

Some of the figures in the table of cubic yards of mortar required per thousand bricks may seem inconsistent at first sight but by comparing these figures with those in the table of bricks required to lay one cubic foot of wall and noting the volume of wall produced by one thousand of a given size of bricks, the apparent inconsistency will be explained.

Section 2

Estimating the Labor Cost of Brickwork

In the previous section, dealing with the cost of the materials which are used in brickwork, I endeavored to show why it is possible for there to be such great differences as we frequently find in two or more estimates submitted for the same piece of work. I also presented figures to show the number of bricks of varying sizes required to lay up a cubic foot of wall and the amount of the mortar-materials required for each thousand bricks of the size selected.

In the present section I shall endeavor to present a method of figuring the cost of brickwork-labor. This method is the one I have been using for years.

I realize that the ideal method of estimating the cost of brickwork would be one which was worked out in as much detail as the method evolved by Messrs. Taylor and Thompson for figuring the cost of concrete as presented in their book "Concrete Costs."

Such a method would involve the finding and tabulation of the necessary unit-times for each such operation as picking the bricks from the pile, loading hods or wheelbarrows, delivering to scaffold, picking up turning, placing, spreading mortar, cutting the joint, pointing, raising the line, plumbing corners and jambs, as well as a number of other operations. Such a method would be very interesting from a theoretical viewpoint and might reasonably be used as means from which to develop more improved methods of handling brickwork, with ultimate reduction in cost.

However, present competitive methods of doing business, as well as present labor conditions, make it impracticable to use such detailed methods, while good business demands that the method of estimating shall be one that gives a figure which will very closely approximate the actual cost of doing the work.

If, even considering the limited time usually allowed for the preparation of bids, the estimator could determine exactly the conditions under which the work will be conducted and the methods that will be used he might be justified in using minutely detailed methods of estimating. Often the estimator will have very little to do with the actual conduct of the work after a contract is closed, so the best that he can do is to exercise his good judgment as to the most desirable method of handling the work and estimate accordingly.

The method which I have outlined herein is intended to be sufficiently detailed for all practical purposes and yet not to be too theoretical. Certainly it is much better than the ordinary method of "sizing up" a job and setting a price per thousand bricks on that basis. The quantities which I have set down herein as a normal hourly production for different classes of work were determined after a careful study of all the published literature that I could find, as well as by collating a great mass of personal experience data. Incidentally, these figures serve to show how much weight should be given to such statements as constantly find their way into the public press as: "Bricklayers in Chicago are now laying two thousand bricks a day, and that is really only half a day's work." You will notice that such statements are not usually made by builders nor by bricklayers; neither do they specify the kind of work referred to.

While the bricklayer's wages may not always be the largest single item in the cost of laying bricks, the number of bricks actually laid per man per hour is usually the determining factor in fixing the cost of the work.

Production

The following table gives the average production that may be expected from competent bricklayers working under average conditions:

Common Brickwork (Joints Struck One Side of Wall)

Thickness of Wall	Bricks per Hour	
	Lime Mortar	Cement Mortar
3′ 0″ thick or over	300	250
2′ 4″ to 3′ 0″ thick	250	225
1′ 8″ to 2′ 0″ thick	225	200
1′ 4″ thick	200	175
1′ 0″ thick	175	150
0′ 8″ thick	150	125

If there be more than the usual number of openings in the wall, or if there be many pilasters which require plumbing, an allowance of five minutes of bricklayer's time for each lineal foot of plumbing should be made.

If joints on both sides of the wall must be struck the production will be about ten per cent. less than the figures given above.

Just at present the actual production in the New England states will only run about 85% of the tabular figures but the proper kind of management should succeed in getting 100% of those figures.

Face Brickwork

	Bricks per Hour
Running bond plain cut Joints	90
Running bond V-joints	70
Running bond raked-out joints	70
Running bond raked-out and struck smooth	65
Flemish bond plain cut joints	65
Flemish bond V-joints	60
Flemish bond raked-out and struck smooth	50
Flemish bond rodded joints	45

Other special and fancy bonds will decrease the production, as also will the introduction of many pilasters, openings, panelling, etc.

Number of Laborers

The number of laborers, or tenders required is, of course, determined by the number of bricks being laid, the distance the bricks must be moved, necessity of culling bricks and other factors. The ratio may be anywhere from four laborers to each five bricklayers up to three laborers to one bricklayer.

The following information will be helpful in determining the number of laborers necessary:—

One mortar mixer, working nine hours, can produce about four cubic-yards of sand-cement or sand-lime-cement mortar.

One laborer can load and wheel about 1120 bricks a distance of forty feet per hour, using barrows, and dump them on the scaffold.

Using a hod, he can make more trips but will probably only transport about half as many bricks per hour as he will with barrows.

One laborer can handle about five hundred brick per hour from car to wagon or from wagon to pile.

Two good laborers working together can handle about sixteen linear feet of pole-staging per hour.

On thick walls one laborer can build, take down and move horse-scaffolding for twelve bricklayers. On thinner walls the work goes up more quickly so that more men are needed to build scaffolds. A fair ratio would be to decrease the number of bricklayers to each scaffold-man by two for each decrease of eight inches in thickness of wall below three feet. It is, of course, assumed that horse-scaffolding will not be used for any walls above normal storey height.

I have not attempted to include figures here for the great variety of patented scaffolds. The estimator who has occasion to figure on their use can usually get the necessary information from the manufacturers or from persons who have used them.

One laborer can cull from two to three hundred bricks per hour, depending upon the quality of the bricks delivered and the stringency of the inspection.

One laborer, using barrow, can deliver about thirty-three cubic feet of mortar a distance of forty feet in one hour.

Two laborers, with a chain hod-elevator, can elevate 2,500 bricks a distance of thirty feet in one hour.

A barrow elevator, operated by a motor or steam engine, can elevate 10,000 bricks a distance of thirty feet per hour.

A two-horse team will travel with an empty wagon at about three miles per hour or at about two miles per hour with the following loads:—

On poor earth roads, 2,000 lbs. equal to 370 average bricks
On fair earth roads, 2,500 lbs, equal to 465 average bricks
On good earth roads, 4,000 lbs. equal to 750 average bricks
On hard surfaced roads 6,000 lbs. equal to 1110 average bricks

Of course, steep grades will reduce both the load and the speed of travel.

Motor trucks can be figured to carry their rated loadings at an average safe speed of eight to twelve miles per hour, and, of course, the same proportionate time must be allowed for loading and unloading as for wagons drawn by horses.

As previously stated the quantities given herein are the average of a great number of published data and considerable personal experience. Actual production will vary very widely in different parts of the country and at different times. Every estimator in active practice will undoubtedly have his own data-book, covering the experience of his own organization, and those data will reflect the skill of the workmen employed as well as the organizing and executive ability of the foreman, superintendent, and higher officials. However, by substituting the proper quantities and taking due account of all local conditions, this method of estimating may be used for practically every job.

Example

As a typical example, we may take the case of an ordinary brick mill building, four stories high, with interior brick walls enclosing the stairways. We will assume that the dimensions are 80 feet by 200 feet and the thickness of the walls as follows:—

	Exterior	Interior
First Storey	20 inch	16 inch
Second storey	16 inch	12 inch
Third storey	16 inch	12 inch
Fourth storey	12 inch	12 inch

Figuring the quantity of bricks by the usual method, and deducting all openings, we find that the job will require about 641,000 bricks, distributed as follows:—

164,000 in 20″ walls on first storey
29,000 in 16″ walls on first storey
139,000 in 16″ walls on second storey
139,000 in 16″ walls on third storey
22,000 in 12″ walls on second storey
22,000 in 12″ walls on third storey
126,000 in 12″ walls on fourth storey

It will be assumed that the sand, cement and lime have been purchased for delivery at the site and that the bricks must be hauled from the siding two miles away over good earth roads and that teams are more readily available than motor trucks. It will be assumed that the stocks of lime, cement, sand and bricks will be stocked about twenty-five feet away from the building and that a steam elevator will be used:

Hourly rates of pay are assumed as follows:—Bricklayers, 90 cts.; laborers, 50 cts.; teams 100 cts.; elevator, flat rate of $20.00 per day, including engineman, fuel, raising for additional stories, etc.

Horse-scaffolding will be used throughout, working from the floor construction and the outside bricks will be laid "over-hand."

Evidently the first thing to do is to get the bricks from the siding to the site. Since the team can haul 750 bricks to a load, and since a laborer can handle 500 bricks per hour from car to wagon, it will take two men about 45 minutes to load a wagon, or where the driver helps to load, it will only require thirty minutes.

The cost per trip is, therefore, as follows:—

Team—		
Loading time	30 minutes	
Travelling loaded at 2 m. p. h.	60 minutes	
Dumping	5 minutes	
Returning at 3 m. p. h.	40 minutes	
	135	
135 minutes at $1.00 per hour		$2.25
Men—		
2 men, each 30 minutes, 60 minutes		.50
Cost for 750 bricks		$2.75

This equals $3.67 per thousand net, so we will use a figure of $3.70 to allow for a few minor contingencies.

It has been assumed here that a sufficient number of teams will be employed to keep the men at the car busy; otherwise their waiting time must be figured into the cost of the work.

In most places it will be found practicable to employ lower priced men for unloading cars, and the figure above may be varied accordingly.

From the method given previously, we find that about 266 cubic yards of mortar will be required to be used as follows: 86 cubic yards on the first storey; 65 cubic yards on the second storey; 65 cubic yards on the third storey; 50 cubic yards on the fourth storey.

Because a job of this size will hardly tax the full capacity of the elevator, the cost of hoisting need not be figured separately for each floor but can be covered by a single item, as will be shown later. Where a building is very high or the number of bricklayers great enough to use the full capacity of the elevator, it is well to estimate the amount of materials to be hoisted to the various heights and to figure accordingly.

From the dimensions of the building and the locations of the piles, it will be seen that the greatest horizontal distance that materials will be transported is about 305 feet, and the average about 165 feet.

Therefore, the total cost of making and delivering the mortar will be as follows:—

Making 266 cu. yds at 4 cu. yds. per 9 hrs., 598.5 hrs, at 50 cents	$299.25
Transporting 266 cu. yds. (using barrows) average distance 165 feet 33 cu. ft. per hour for 40 feet, 897.7 hrs. at 50 cents	448.85
Labor Cost of Mortar	$748.10

Figuring three scaffolds per floor (if we can work from the floor plank we shall only need two scaffolds per floor) above the first and two on the first floor, we find that we need 6,160 ft. of scaffolding which must be built, taken down and rebuilt rapidly enough to provide for the number of bricklayers employed. This job appears to require about 512 hours of scaffold builders' time, which at 50 cts. per hour equals	$256.00
The cost of taking the bricks from the pile and transporting them, by barrows, to the scaffold, an average horizontal distance of 165 ft. at the rate of 10,120 bricks 40 ft. per hour, will be 2,361 hr., which at 50 cts. per hour equals	$1,180.50
Laying the bricks will take, for 20 in. walls, 164,000/200=820 hr.; for 16 in. walls, 307,000/175=1,754 hr. and for 12 in. walls, 170,000/150=1,133 hr.; a total of 3,707 hr. which at 90 cts. an hour is	$3,336.30
Since the walls on this kind of a job must be pointed on both sides, the production will be decreased 10 per cent which means that the number of hours must be increased by one-ninth, thus: pointing, 412 hr. at 90 cts. is	370.80
If the average force is to be fifteen bricklayers, the job will run for at least 36 working days, but, since allowance must be made for rainy days and other delays, a mason foreman will have to be on the job for at least 40 days, and his rate will be about $48 for a 5½-day week, or 7.3 weeks, which equals..	350.40
Since all of the bricks above the first floor must be elevated, an elevator will be needed for 22 of the 31 working days, and this will cost, at $20 per day..	440.00
We now have a total of	$6,682.10
for the labor cost on the job (which is an average cost of $10.42 per thousand). To this must be added the cost of unloading and carting which, at $3.70 per thousand equals	2,371.70
(Of this amount approximately $448.70 is payroll and $1,923, is team hire).	
To wash down the building, two bricklayers and two laborers will be required, each working 7 days of 8 hr. each, or a cost of	156.80
Labor Total	$9,210.60
Compensation insurance, figured as 5% on payroll and 3% on team hire will be	422.07
	$9,632.67

To this figure must be added the cost of supervision, building shanties, any contigent items which local or seasonal conditions make necessary, office expense and profit.

I have not attempted to discuss such items as cutting and grinding for arches, building quoins or ornamental cornices, though proper allowance must be made for each item. However, it is almost impossible to set down figures that will be of any value without examining the design in each case. I usually allow at least ten minutes of bricklayer's time for each brick that must be cut and ground and ten minutes per running foot of each projecting course. These amounts I add to the total cost of doing the work.

A Shorter Method

A shorter method of estimating and one which while it is neither so accurately or so detailed as the one described above, may be used where the estimating time is limited, is outlined in the succeeding paragraphs.

The job which we have just been considering is a "fair average" of what comes to the contractor who specializes in industrial buildings and it brings out the following facts:

The total number of hours of bricklayers' time, exclusive of foreman or of cleaning down but including the extra pointing, is 4,119, and the average number of brick to be laid per hour is 173 or 1,384 per 8-hour day.

The total number of hours of laborers' time, exclusive of unloading and carting or cleaning down is 4,367.8 or, in other words, for each 8 hours of bricklayers' time and we shall require almost 8½ hours of laborers' time, including the scaffold builder.

We also need 0.09 day of the forman's time and 0.05 day of the time of the elevator.

Using these figures we get:

8 hrs. bricklayer at 90 cts.	$7.20
8½ hrs, laborer at 50 cts.	4.25
.09 day foreman at 8.75	.79
.05 day elevator at 20.00	1.00
	$13.24

Taking the day's production as 1,384 bricks laid, less ten per cent. for extra pointing, we get $\frac{\$13.24}{12.46}=\$10.60$ per thousand, to which must be added the insurance, cost of unloading, hauling, etc., as though we were using the more detailed method.

It will be noticed that the result obtained, $10.60 per thousand, corresponds fairly closely with the figure of $10.42 obtained by the detailed method. It must be remembered, however, that we were using this latter method in actual practice we should probably use some arbitrary figure such as 1,250, 1,300, 1,350 or 1,400 bricks laid for a day's work, and should then get the following costs, respectively, $10.59, $10.19, $9.81 or $9.46 per thousand.

While the relative number of hours for the two classes of men will change but little over a wide range of sizes of mill-type buildings, the daily production will vary widely and should always be calculated as closely as circumstances will permit.

The amount of foreman's time and elevator time will be boverned largely by the number of men that can be employed and that number in turn, by the size of the building and other conditions, and these two items may vary as much as fifty cents to one dollar per thousand in the cost of the work.

Whichever method of figuring is used, the cost of culling the bricks for facing, where such is necessary, must be added.

Where pressed or face bricks are used it will usually be necessary to figure on two scaffolds, an inside scaffold for the backing and an outside scaffold for the facing.

It should also be remembered that, because of the added unit-weight of pressed bricks and the greater care required in handling any kind of face bricks, the number handled by the laborers in a given time will be only from two-thirds to three-fourths as many as the number of common bricks handled in the same length of time. The best method is to make a separate item in the estimate for common brickwork and one for face brickwork.

For instance, if the building under consideration had been faced on one side and one end with pressed bricks, our quantities would have been as follows.—

69,000 pressed bricks; 82,000 common bricks in 20 inch walls; 234,000 common bricks in 16 inch walls; 211,000 common bricks in 12 inch walls; 45,000 common bricks in 8 inch walls.

This will change our estimate on the bricklayers' time as follows:—

20 in. Walls 82,000/200= 410 hrs.
16 in. Walls 234,000/175=1338 hrs.
12 in. Walls 211,000/150=1405 hrs.
8 in. Walls 45,000/125= 360 hrs.
3513

The cost of making the mortar will be practically the same as before, as will also the cost of the hoisting, so we shall simply pro-rate those two items to the different classes of brickwork as follows:—

	Face Brick (69 M)	Common Brick (572 M)
Mortar Cost	$80.53	$667.57
Hoisting Cost	47.25	392.75

The cost per thousand of hauling the common bricks will be the same as before but the press bricks will weigh more and must be handled more carefully, the load being only 625 bricks. The loading time is the same as before but the bricks must be unloaded and piled instead of being dumped.

The hauling cost will, therefore, be as follows:

Team, moving 100 minutes, loading 30 minutes, unloading 30 minutes; Total 160 minutes at $1.00 per hour	$2.67
Men, two, each 30 minutes loading and 30 minutes unloading	1.00
Cost for 625 bricks	$3.67

which equals $5.87 per thousand, or, say, $5.90.

The cost of placing the common bricks upon the scaffold will be proportionately as before, 2,177 hours at 50 cents, which epuals	$1,088.50
The cost of placing the face bricks npon the scaffold (figuring 840 per hour instead of 1120 per hour) will be 83 hours at 50 cts., which equals	41.50

Note:—The location of the hoist and stock piles, with respect to the sides requiring pressed bricks, will influence the cost of this item. For convenience I have assumed the same distance as before).

The cost of laying the face bricks will be 69,000/90 at 90 cts. per hour	$690.00
A pole-scaffold will be required for the face bricks and there will be 11 lines of scaffolding, 280 feet long or 3,080 linear feet. This will require 385 hours laborers' time, which at 50 cents per hour equals	$192.50

A summary of our face brick estimate will, therefore, be as follows:—

Carting 69,000 bricks at $5.90 per M	$407.10
Mortar	80.50
Hoisting	47.25
Handling	41.50
Laying	690.00
Scaffold	192.50
Cleaning Down (one-half of building faced)	78.40
Total	$1,537.25

(Equals $24.14 per M or $18.24 per M, exclusive of carting).

The summary of the cost of laying the common bricks will be as follows:

Carting 572 M at $3.70	$2,116.40
Cost of making mortar	667.57
Cost of hoisting	392.75
Scaffold (as before)	256.00
Handling	1,088.50
Laying—3,513 hrs. at 90 cts.	3,161.70
Extra pointing time (since only 399 thousand of the common brick will be in walls requiring pointing on 2 sides, this figure will be:— $\frac{1}{9} \times \frac{399}{572} \times 3513 = 272$ hrs. at 90c)	244.80
Cleaning down (½ of building)	78.40
	$8,006.12

Which equals $13.98 per thousand, or $10.28 per thousand exclusive of the cost of carting.

Now, our combined brickwork figure will be made up as follows:—

Total cost of face brickwork	$1,665.75
Total cost of common brickwork	8,006.12
Foreman—figured on the same basis as before, but for 44 days instead of 40	384.00
Total labor cost	$10,055.87

To this must be added the cost of compensation insurance and all the other items of overhead expense, as previously explained.

Large Business Block in Vancouver, B. C.

First Building of the Knid of Any Considerable Size to be Erected for Some Time —Work Already Under Way

A contract has been let to Messrs Adkinson & Dill, contractors of Vancouver, for the construction of a store and office block on the corner of Granville and Robson Sts., Vancouver, B. C. The contract price is about $112,000, and work was commenced at once, excavation for the basement and foundation walls being already practically complete.

The building will be of three storeys, the ground floor being of steel construction and the two upper floors in mill construction. The ground floor will be devoted to stores. The first floor will be fitted up for use as doctors' or dentists' offices, or as general business offices, and the top floor will probably be arranged as an assembly or dance hall, with anterooms suitable to the purpose.

The architects for the building are Messrs. Maclure and Mort, of Vancouver, and the owner is E. D. Farmer, of Fort Worth, Texas, U.S.A., represented by Messrs. Sharples and Sharples, agents, of Vancouver, B. C. This is the first business block of any considerable size to be erected in Vancouver for some time, but several other buildings of this nature are in contemplation or in the plan stage at present, and a revival of activity in this line of contracting is quite likely to ensue.

Excavating for new store and office block in Vancouver, B.C.

Partial Construction of Sewer System at Chilliwack, B.C.

Additional Pumping Station to Make the Lift in Two Stages—Vitrified Clay Sewers

Tenders will shortly be considered for the partial construction of the sewerage system of the town of Chilliwack, B. C., in the business section of the town. The work will include an additional pumping station to the one now in operation, which will have the effect of making the lift in two stages, instead of in one as at present. The consulting engineer, Mr. C. Breckenridge, of Vancouver, decided on this feature of the work as the most satisfactory means of avoiding the treacherous quicksands which are encountered in deep trenching in this section of the country, the general average depth being kept between five and six feet in the firm upper stratum.

The sewers to be laid will be of vitrified clay pipe in size from 12" to 6" and the force main from the pump station will be of 6" diameter cast iron pipe and will be 283 feet in length. The pump station itself will be of concrete, 14' x 12' in plan, and will be equipped with two 4" vertical centrifugal pumps, electrically driven, with automatic float control.

No changes are being made in the town's sewage disposal system, which as at present organized consists simply of two separator or sediment tanks, without septic action. Sludge from the tanks is periodically removed and used as fertilizer in the neighborhood.

Quantities Involved

The work includes something over 3,500 cu. yds. of excavation and backfilling and the following schedule of quantities, in which the principal items only are listed:—

12" vitrified pipe	2,210 ft.
10" vitrified pipe	1,763 ft.
8" vitrified pipe	1,186 ft.
6" vitrified pipe	393 ft.
6" cast iron force main	283 ft.
Plank pipe supports	6,000 fbm.
Concrete 1.3.6. for pipe cradles	90 c. yds.
Manholes and lampholes	25 app.
Pumping station excavation	120 c. yds.
Pumping station concrete	60 c. yds.
Pumping station reinforcing steel	1,800 lbs.
Pumping station waterproofing	1,120 sq. ft.

Special Methods Developed to Handle Vancouver's Paving Programme

80,000 Sq. Yds. of Asphalt Penetration Pavement Have Been Contracted for—Material Supplied to Contractors at Working Temperature—Spraying Device of New Design

By J. B. HOLDCROFT, A.M.E.I.C.
Contract Record Correspondent

Paving contracts totalling 80,000 sq. yds. have recently been let in Vancouver, B. C., to the United Paving & Construction Co. Ltd., of that city, and rapid progress is being made with the work, which will be all laid within the present season. The contract covers about ten miles of streets, distributed over the city, the policy of the city works department being to improve a network of primary roads before extensive improvement programmes are undertaken on roads which are purely residential in character.

The width of the pavement is 16 feet in nearly all cases and the type is asphalt "penetration system," a system which is being brought to a high degree of perfection by the Vancouver engineers. It is also very economical, the contract price, excluding the preparaton of the subgrade, which is being done by the department of works by day labor, being $1.84 per square yard. No curbs or edge pieces are used, the asphalt finishing up against the clay subsoil.

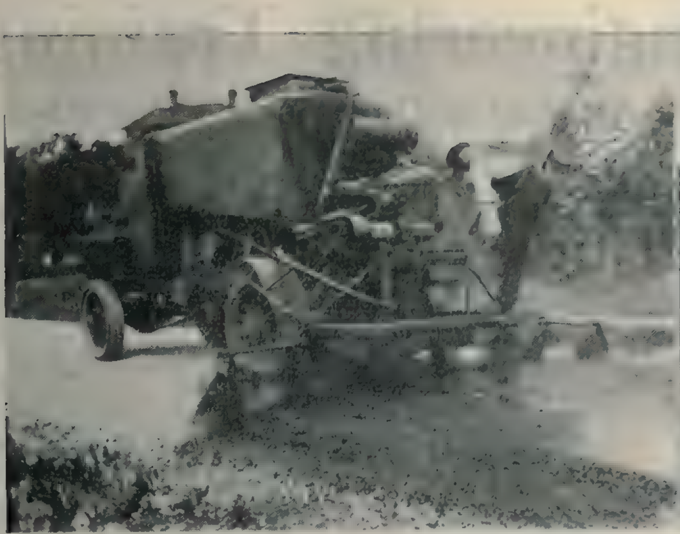
Eight inches of rock, compressing to six inches, are used in the construction of the pavement. The material is laid in two courses, the first consisting of a 5 inch thickness of coarse rock about 3 inches in size. This is rolled and keyed with a light layer of ¾ inch rock, the rolling being continued until the base is thoroughly compacted, but being stopped before the material commences to fracture. This is then given a coating of hot asphalt at 300 degrees ½ gallon being used to the square yard. The next layer of stone consists of 3 inches of 1½ inch rock, which is also rolled and sprayed with asphalt, 1½ gallons being used to the square yard in this case. A 1 inch coat of ¾ inch rock is rolled on following the heavy application of asphalt, and is finished with a flush coat of asphalt of ½ gallon per square yard, and the surface is finished off with a light layer of torpedo gravel or crushed rock, (¼" size) which is rolled heavily on a hot day to bring up the asphalt to the surface.

Tank car, with asbestos and galvanized iron lagging, used to carry hot asphalt from refinery to contractor's yard

The particular advantages claimed for this type of pavement are the cheapness and ease of construction; the short time the roads are necessarily closed to traffic; the fact that the construction is exceptionally solid and long wearing, due to the rolling of the material before the application of the asphalt, which greatly assists the production of a firm mechanical bond or interlock; the possibility of accurate selection of materials and their proper disposition and gradation of sizes throughout the thickness of the pavement. Experience has proved main-

Spreading ¾ in. chips over rolled first course prior to application of asphalt

Spreading second course over asphalted lower course



Spray machine applying 1½ gal. of asphalt per sq. yd. Blown on road by live steam, the penetration is excellent

Applying asphalt with hand spray at intersections

tenance charges to be exceptionally low for this type of pavement under Pacific Coast conditions.

Special Construction Methods

Some unique and most economical methods have been devised by the United Paving & Construction Co., the contractors, for the handling of this type of work, which is their specialty. Mr. D. Johnston, the manager of the company, has had a very extensive experience in that line, as engineer to the municipalities of South Saanich and Point Grey, B. C. The constant supply of hot asphalt being, of course, one of the main problems, it has been found possible, with the co-operation of the Imperial Oil Company, who supply the material, to have it delivered at the contractor's yard at practically the working temperature of 300 degrees. Four tank cars have been specially fitted for this purpose, with a coating of 2 inches of asbestos cement and galvanized iron lagging The cost of fitting the tanks is said to be about $1,000 each. The scheme has proved entirely successful, the asphalt arriving at the yards at practically the same temperature it had on leaving the oil company's works at Ioco, B. C. In some cases cars have been delayed through shunting operations, and have taken from ten to twelve hours in transit, and it has been found that in these cases only about twenty degrees of heat were lost.

The ordinary system for heating at the yard is in use, the paving company having installed a donkey boiler to supply steam to the coils in the tank car and for heating the delivery pipes. The fact of the cars having been insulated, however, makes it only necessary to maintain the existing heat, or to pick up the few degrees lost in transit instead of the usual necessity of entire reheating which has been the rule heretofore.

Spraying Device of Special Design

For spraying the asphalt the paving company is using a special machine which is the invention of Mr. Johnston, and which has proved entirely satisfactory in its trials on this work, averaging a performance of 4,000 gallons per day sprayed, with a three mile haul to the yard for refilling.

The spray machine, which is mounted on an ordinary three ton truck chassis, consists essentially of three main parts, the storage tank of about 500 gal. capacity, a small boiler, and the pump and engine, to which is connected by a system of piping the tank and the adjustable spraying nozzles, which can be adjusted to any desired width of road.

The boiler is fired by a three burner oil furnace, and maintains a head of steam which supplies the coils in the storage tank, which is insulated with asbestos, and which also supplies live steam to the nozzles and their piping system. It is this feature of the machine which has made it practical to spray with ashpalt as the pipes are kept clear at all times by the steam, which is turned on before the asphalt enters the pipes and is left flowing for sufficient time after the flow of asphalt has been checked to completely clear the system. The nozzles used are exceedingly simple, and without any internal obstructions. They are of the exposed jet type and throw a broad, fan-shaped spray so adjusted that every inch of width of the road is covered.

The pump is of the rotary type and is reversible, so that it can be used either for filling the storage tank from the tank car, or for its primary purpose, the pumping of asphalt to the jets. It is driven through a clutch, in this first machine by a Ford automobile engine mounted just behind the tank. The pump runs at constant speed and adjustment of the required flow through the nozzles is made by allowing a certain quantity of the asphalt to return to the tank by way of a by-pass.

Adjustment of the application is also made to some degree by regulation of the speed of the machine in passing over the road, but the principal adjustment is the by-pass just mentioned. As stated, the width of application is regulated by adjustment of the length of the nozzle arms. Street intersections, however, are covered by a hand spray, manipulated by one of the machine operators, and supplied with steam in exactly the same manner as the fixed nozzles. Application for patents covering the machine has been made by Mr. Johnston, the inventor, and it is to be expected that it will have an exceedingly useful future, judging from the performance which is being maintained on the present contract.

The new Coliseum at the Canadian National Exhibition is the largest and most costly building ever erected on a permanent Fair grounds. It cost $1,000,000, while an additional $250,000 is being spent in equipment.

Essentials of an Engineering Training

What the Technical Colleges Should Attempt to Develop in Those Who Aspire to the Engineering Profession—How They Fall Short of Modern Demands

In view of the fact that the technical colleges throughout the country will soon be reopening for the fall term with a fresh registration of engineering aspirants the following paper by John H. Dunlap is of interest. Mr. Dunlap is secretary of the American Society of Civil Engineers and was formerly professor of hydraulics and sanitary engineering at the University of Iowa. He can, therefore, write with authority. The paper was presented to the Society for the Promotion of Engineering Education.

In 1918, Charles R. Mann reported in Bulletin No. 11, Carneigie Foundation for the Advancement of Teaching, "A Study of Engineering Education" that he sent to the 30,000 members of the four founder engineering societies a list of six groups of qualities headed by character, judgment, efficiency, understanding of men, knowledge, and technique. He requested that the list be returned with these six qualities numbered in the order of their importance in determining engineering success. In the seven thousand replies which were received, the character group was voted almost unanimously a place at the head of the list while technique was at the bottom of the list. While we all agree as to the importance of character, we all know that without a mastery of technique, an engineer is a failure. Such a discussion is fruitless. Furthermore, to tell an engineering college that character is important without indicating the educational process by which the college may develop character, is not of great assistance.

Ten Essentials

In that which follows an attempt is made to specify the sources from which character springs, in so far as the engineering college is concerned. I believe that no one of the accomplishments to be specified can be omitted from the preparation of the engineer without failure resulting. The first five specifications are general, and represent acquirements that every educated man should have. The last five are more technical, and represent the additional acquirements peculiarly necessary for the engineer.

1. Every educated man shall know his environment. To know one's environment in this era requires at least an understanding of the principal facts of history, biology, geology, and astronomy; mathematics, physics and chemistry; sociology, political science and economics. It would be impossible for everyone to cover the details of these subjects as they are now presented in most of our curricula. Readjustment of our present water-tight compartment system of departmental organization would have to be made.

2 Every educated man shall know himself. Self, as here used, has the broad meaning which includes not only the individual ego, but also things and people that act and react upon the individual. For a man to know himself, he must know those great storehouses of human thought and aspiration, literature, music and art. He must know the principal facts of philosophy and of psychology. The task today of knowing self is far more difficult than in the days when to "know thyself" became the ideal of the young Greek. And yet many of our graduates do not attain even the standard of the Greek, to say nothing of that early Hebrew discovery in psychology: "The fear of the Lord, that is wisdom; and to depart from evil is understanding." Illustrations of the failure of modern education in these respects are all too easy to find. For example, I have had an experience with a graduate student which has made me very thoughtful concerning a system of education which permits a man to become a graduate student, who is still a child so far as his knowledge of himself and of his environment is concerned.

3. Every educated man shall think well.

4. Every educated man shall write well.

5. Every educated man shall speak well. It would seem that these last three specifications were so axiomatic that our educational process would insist upon them. If one really wishes to know, however, how little attention is paid to these accomplishments in our engineering courses, he should serve as secretary of a good-sized engineering society. Such an experience would lead inevitably to the conclusion that a pitably small percentage of engineers can think well, write well, or speak well.

6. Every engineer shall know the sources of scientific information. He should be at home in libraries, and be able to determine what has been written upon any subject in which he may be interested.

7. Every engineer shall be skilled in using the method of applied science to solve engineering problems. He must, of course, first master the fundamental principles of applied science so far as they are tools of the engineer. Right here the line is most sharply drawn between the engineer and the physicist, between the applied scientist and the scientist. The physicist needs only to know the fundamental principles of science, while the engineer must not only know them, but also know how to apply them.

8. Every engineer shall be thoroughly trained in costs and values. One definition of an engineer is that he can do for one dollar what anyone can for two. In almost all engineering work the final control of design and construction is cost. Despite the controlling importance of costs and values, very little of scientific worth concerning them is to be found in our textbooks, or magazines.

9. Every engineer shall prove himself to be an economic asset in his work, and shall understand the commercial and ethical aspects of professional practice. Throughout his entire college course he should be taught to look upon himself as one who by his peculiar skill can save his employer much useless expenditure, whether his employer be a private individual, or a group of individuals like a county board of supervisors, a city council, or the public in general Many of the counties in Iowa are so little convinced that an engineer is an economic asset to them, that they do not hesitate to advertise for bids for engineering services, and to accept the lowest bid. Only a few weeks ago such a case occurred in one of the counties. The secretary of the Iowa Engineering

Society, learning at the last minute what was planned, sent the county auditor a letter which arrived at the moment the bids were being opened. Therefore, the letter was opened and read along with the bids. Part of it read as follows: "Your county engineer is a vital factor in the conduct of the affairs of your county, and upon him depends a great deal how much money is saved to your county in carrying out the road program. It is considered unethical among the best class of engineers to submit bids on the basis of salary, and for this reason your county, more than likely, will not get the best engineering services. The best engineer you can get should save your county more than his salary in any year. If he cannot, he has very little excuse for existing. With these facts in mind you will see that it is to your interest to employ your engineer on the basis of his fitness for the position." Strange to say, the board of supervisors was so impressed by this letter that they rejected all bids and re-employed their former county engineer. This situation would never have developed if this conuty engineer had been taught, in his college days, to look upon himself as an economic asset to his employer, and if he had been taught the necessity of proving it to his employer from time to time. Anyone who does not enjoy cost data, whether applied to construction work or to his own job, probably is out of place in the engineering profession.

10. Every engineer shall be taught throughout his college course that one of his chief functions is to serve his community. Recently I asked Dr. Edward T. Devine, the sociologist, in what direction he considered the greatest hope of our municipalities to lie. He answered at once, in substance, in the application to community affairs of the abilities of technically trained men. In spite, however, of the manifest opportunities for service in our communities, composed as they are today principally of engineering units, ous engineers do not occupy their rightful positions of leadership. At a dinner some time ago, I asked a woman who was a leader in the community affairs of her town, a small county-seat of less than four thousand population whether she was acquainted with the county engineer. Imagine my surprise to learn that she had not yet heard of him. As a sequel to this story, it should be added that a few weeks ago this county changed county engineers. Of course part of the trouble is that the training of the engineer is so narrow that he feels himself uncomfortable and embarrassed when he attempts to help in public affairs. If the major part of the above specifications could be carried out, the engineer would find himself, as the years of practical experience came to him, the best prepared man in his community, and as a natural result, would assume leadership. While this has an important bearing on the relative standing of engineering as compared with other professions, it is even more important from the viewpoint of the community, and its need of men skilled in the method of applied science.

Specifications Not Met

The first five specifications, which are really essential to every man who calls himself educated, are for the most part ignored in our present engineering courses. Of the last five, which are intended to apply particularly to engineers, only one now receives careful attention; namely, the seventh, that every engineer shall be skilled in the knowledge and application of the fundamental principles of science. The other nine specifications may be met after graduation, and some engineers have found time to do this, but for the most part, the young graduate finds himself so busy for the first ten years furthering his knowledge of technique that he has little time for other study. Except for the successful few, therefore, some substantial progress in these ten objectives must be attained before graduation.

The Time Required

To cover the ground outlined, the course probably must be lengthened to five, and eventually to six years, although much time can be saved by certain modifications of the existing four-year course.

But it would probably be unwise to require all the students who begin an engineering course to take the entire five or six years. A better plan would be a two-stage method, similar to that by which engineering is now taught in France and Italy. To quote from the report of the Committee on Technical Education of the Mining and Metallurgical Society of America; Bulletin No. 150, Vol. 14, Sept. 30, 1921, p. 175: "In France and Italy engineering is taught in two stages. The more advanced stage which aims to turn out actual engineers of training, ability, and power, is open only to those who have proved their right to enter it by conspicuous ability and fitness in the first stage. And the first stage, though preparatory to the second, is so designed that the majority whose college career ends with it are not turned loose as two-spot engineers, yet ill-fitted by training and because of pride to do anything else. Instead, they are equipped to step into positions of intermediate responsibility, where they do high-grade work with entire self respect."

This suggests that the first four years of an engineering course be planned to fit men with no particular engineering ability to assume the subordinate positions in industry. The regular college degree of B. S. might be given at the conclusion of the four-year period. Then those who have shown themselves fit for advanced technical work in engineering should be encouraged to enter the fifth, or the fifth and sixth years of the complete course, from which they might be graduated with the professional degree of C. E.

The Challenge

We should not be alarmed at the suggestion to increase the length of course, in order to prepare the engineer more adequately. During the early history of the Rensselaer Polytechnic Institute, one year was sufficient. We have, therefore, already added three years to the course, and should expect to add more as science expands. The engineer has been making over the world until we are now in the midst of a mechanical age. Notwithstanding this, we have allowed the preparation of our engineers to lag behind the preparation for the other professions, and have actually lost the position of leadership occupied twenty years ago. Dean Mortimer E. Cooley, pase-president of this society, recently expressed it in this way: "The engineer a generation ago was better prepared to do the work of his generation than is the engineer of today prepared to do the work of this generation."

We should insist that the engineer be the most carefully prepared man of our generation. He should know his environment and know himself; he should think well, write well, and speak well; he should be familiar with the sources of scientific information; he should know the fundamental principles of his calling and their application to the work of his profession; he should understand the controlling importance of costs and values and become an economic asset wherever he goes; and he should lead in every type of service that goes to upbuild not only his community, but his nation, and the world. Even as science and industry today are international, so should be the thinking of the engineer.

Concrete for Water-Holding Structures

The Economy of Reinforced Concrete Both in Capital Cost and Maintenance—Reservoirs, Dams and Pipes of Concrete—Discussion of Special Points

By H. C. RITCHIE

Read before the Institution of Water Engineers (British)

(Continued from last issue)

Having referred to conditions which must be observed in the design and construction of water-holding structures, all of which must tend to increase their cost, the question is raised as to whether or not reinforced concrete can be substituted economically for the older-established materials of construction.

It is quite obvious that no general assertion in the affirmative can be made, as so much depends upon local conditions, materials available, class or type of structure under consideration, and the alternative structural material with which reinforced concrete is compared.

Advantage of Concrete

As an alternative to structural steel or a combination of structural steel and cast-iron in the construction of water towers or tanks, there can be no dispute as to its very marked economy, both in capital cost and cost of maintenance, and as reinforced concrete undoubtedly lends itself much more readily to architectural treatment there seems to be no sound reason why its adoption should not be universal in this connection.

The same advantages, although perhaps not always so pronounced so far as initial cost is concerned, makes reinforced concrete preferable to structural steel as a material of construction for bridges and similar structures exposed to the action of the weather. The cost of maintenance, which is extremely heavy under the best of conditions in the case of naked steel structures, is reduced almost to nil in the case of reinforced concrete, and for fuel storage bunkers this material has an additional advantage on account of its superior fire-resisting qualities.

As a substitute for masonry, brickwork or mass concrete, its economy and general superiority cannot be claimed in quite the same terms. In the case of tanks or reservoirs situated almost entirely above ground, however, it may be said that reinforced concrete under average conditions is more economical in first cost, and possibly is less expensive in maintenance charges than the alternatives referred to.

It is probably exceptional, however, in this country, although quite customary in situations where severe frost is not to be contended with, to construct service reservoirs of appreciable size entirely above ground and without earth embankment; but the author has met such cases where, for reasons of economy or difficulties of the site, earth embankments have been dispensed with altogether, and in this class of construction the economy of reinforced concrete construction is most marked.

The following estimated comparison of cost is a striking example of the economy of reinforced concrete where structures of equal strength are compared:—

Reinforced concrete wall, per bay of 8 ft. 6 in. length.

		£	s.	d.
4 1/3	yds. cu. Concrete .... at 60s. cu. yd. ..	13	0	0
42	yds. sup. Timber centering at 5s. sup. yd. ..	10	10	0
29	cwts. Reinforcing steel including bending and fixing at 17s. cwt.	24	13	0
	Total per 8 ft. 6 in. bay	£48	3	0
	Total per foot run of reinforced concrete wall	£ 5	13	3

Mass concrete wall per foot run:—

		£	s.	d.
4	yds. cu. Concrete .... at 24s. cu. yd.	9	12	0
2¼	yds. sup. Internal centering at 5s. sup. yd.	0	11	3
3	yds. sup. External centering at 3s. 6d. sup. yd. ..	0	10	6
	Total per foot run of mass concrete wall	£10	13	9

Service Reservoirs

For service reservoirs mainly or wholly in the ground, or surrounded by earth embankment, the result of a comparison of costs depends largely upon the relative bases of design of the alternatives. For example, the walls of a reinforced concrete reservoir under such conditions would be designed to take the maximum external earth pressure—i.e., with the embankment in a wet condition—while the reservoir is empty, and alternately the full internal water pressure less the minimum statical earth pressure exerted on the outside of the wall—i.e., with the embankment in a dry condition.

The author has noted, however, that in the case of mass concrete construction, designs quite frequently cover the first condition only, and that reliance is placed upon the earth embankment to resist the bursting pressure with the reservoir full. Whereas if the statical pressure only of the earth on the back of the wall be taken as the maximum assistance from the embankment, a much heavier section of wall results.

For the roofs of service reservoirs there is probably no more suitable material of construction than reinforced concrete, unless it be a combination of mass concrete arches or domes with reinforced concrete beam or arch supports, which under certain conditions might be less expensive than reinforced concrete slabs and beams.

From structural considerations the author dislikes the use of large steel section in concrete work, as the effect of embedding such sections in concrete is to prohibit them from working as they were designed to do. This practice is always wasteful of material, and there is always difficulty in suitably protecting comparatively extensive flat steel surfaces to which the concrete will not effectively adhere.

Reinforced Concrete for Dams

Reinforced concrete has not so far been effectively used in this country for the construction of dams or impounding reservoirs of any very considerable size, although there are now probably a hundred or more successful examples in America.

One of the earliest, and a very notable example, is the Ambursen dam, built nearly twenty years ago, and of this type about seventy more recent examples are now in existence.

The general arrangement of construction of such dams is a flat slab on the water face, carried upon transverse buttresses, spaced according to the requirements of the water load. These buttresses are in turn carried upon a continuous horizontal foundation slab designed to distribute the load uniformly in the longitudinal direction of the dam.

The water face is usually inclined at about 45 deg., and it will be obvious that with this slope of upstream face and with the faces of the buttresses vertical on the down stream side, the central line of water pressure when the reservoir is full, will cut the base on the outer edge of its middle third, so that a combination with the weight of the structure itself will bring the resultant thrust just within the middle third.

If a more uniform distribution of ground pressure is considered to be desirable, this can be attained by including the down-stream faces of the buttresses, and a batter of 1 in 4 will bring the resultant approximately on to the middle line of the base, so that a uniformly distributed foundation pressure will be given when the reservoir is full.

Since the construction of the Ambursen dam, several designers have developed modified types of hollow concrete dams, although there has been little departure from the general arrangement described.

The most notable modification has been the substitution of arched slabs, with buttresses spaced further apart, for the flat slab water face with closer spaced buttresses. The first example of such multiple arch dam was one built in California for the Hume-Bennet Lumber Company, about four years later than the Ambursen dam.

From the structural point of view the flat slab type is probably the sounder and more economical.

It has been stated that the hollow concrete dams referred to have been less costly in construction than equivalent mass concrete or masonry dams, and it must be agreed that they offer very distinct advantages where ground-bearing values are limited.

Pipes and Culverts

For pipes and culverts, reinforced concrete of the class referred to in this paper is probably economical only in the case of larger diameters or sections and under limited heads of pressure, say, in excess of 3 ft. 6 in. diameter and not in excess of, say, 40 ft. head of pressure.

For culverts of from about 20 sq. ft. to 80 sq. ft. internal sectional area, the author's experience is that a square or rectangular box section is usually much more economical in cost than the circular section, which, if figured on the accepted basis of design of reinforced concrete, calls for a greater quantity of concrete, more expensive temporary centering and more costly labor in construction, in addition to increased excavation.

Smaller diameter pipes, to compare economically with iron or steel, must be designed on quite a different basis of calculation and constructed by means of some special process which will ensure a concrete of a higher and more uniformly reliable tensile efficiency. Such special methods of manufacture do not come under purview of this paper.

The author does not claim that in every individual case of the types of structures to which he has referred as being suitable applications of reinforced concrete it will be economical to adopt it, but its consideration is, in the majority of such cases, well worth while; and if its economy cannot be established for the complete structure under consideration, it can almost invariably be adopted to advantage for some portion thereof, or some modified or improved form of reinforced concrete construction suitable to the particular requirements of the case might be evolved.

Institution of Water Engineers Discussion

The reading of Mr. Ritchie's paper at the recent summer meeting of the Institution of Water Engineers (British) was followed by an interesting discussion which is reported in "The Surveyor" as follows:

Mr. F. Storr (Wrexham) said it was more than forty-five years ago since he first used reinforced concrete, when he used very small angle irons, square bars, etc. The reservoir which he then built was not quite watertight—probably the cement was not quite so good as it might have been. He had a second one built later, which was watertight. It was made with inferior material, compared with the first, but he had come to the conclusion, after a long experience, that they must not expect that because they had one wall right they would have the second one right. When the members visited the Chester waterworks they had not seen the area on which it had been proposed to put the sedimentation reservoir, which was to be constructed in reinforced concrete on the lines shown by Mr. Ritchie in the paper. When the question came up for consideration as to what was to be done with regard to expansion, he put that question to all the contractors, both American and English, and said that the company were prepared to pay them so much money, but they must give the company a bond (because the amount of the contract was a pretty heavy one—it was an area of over 5 acres) and if they would give the company a watertight structure, based upon their own designs, they would have £5,000; but if the reservoir leaked they would have to pay the company £5,000. Not a single contractor would take it, although the prices were varied to give them plenty of profit. Not a single firm would guarantee that their concrete tank would not leak. He believed it was an exception to find either a reinforced concrete or a mass concrete tank which was absolutely bottle-tight, and he did not know, after all, whether it was essential that it should be bottle-tight. He had one observation to make with regard to the expansion joints made of lead. In all the works he had been associated with he had invariably specified copper, following the American practice. Those who had had the opportunity of studying American practice would know that nearly all the great dams built in the Adirondack mountains were built in blocks. They separate the blocks like so many pieces of stone, and put expansion joints in between. Whether the structures were watertight he did not know, but such was the uncertainty of concrete that they would never get two structures to expand alike. Concrete was opposed to all "encouragement," and would crack where it liked. He would ask for the author's view as to what length they were permitted to go before putting in expansion joints, and at what length apart was it safe to put them in.

Mr. H. P. Hill (Manchester) said the expansion of concrete varied considerably according to the position and degree of exposure of the work. For instance, water towers were often constructed of that material, and there were several examples of the type in this part of the country. He had a particular tower in mind where the depth of water was fairly constant at some distance below the top, and whether it was due to that fact or not he did not know, but there was a general horizontal zone of dampness to be seen about the water level. It occurred to him that it might be due to the fact that about half the reservoir was exposed to the sun, without the cooling influence behind the wall of the water which kept the lower part at a more constant temperature. Turning to another matter, he would like to mention a rather interesting personal experience in connection with the Bracebridge Service Reservoir at Lincoln. That reservoir was about 200 ft. diameter, and it was constructed in six sectors, each about 100 ft. in length. It was made about 1911, a good deal of the wall being built in the spring of that year, and the remainder in the following summer and autumn. Nothing happened during the succeeding winter to five out of the six sectors, which stood without any trouble whatever, but the sixth, which had been made in the previous summer, divided itself equally into two 50-ft. lengths. The wall split vertically in a true and even line, the action of natural causes thus spontaneously forming another expansion joint at the centre of the block where the tension due to contraction was evidently most severe. The type of expansion joint adopted in that case was very similar to that shown on the section in the paper, but this incident served to show how concrete will, under certain circumstances, accommodate itself if suffcient provision be not made to meet contingencies arising from variability of temperature.

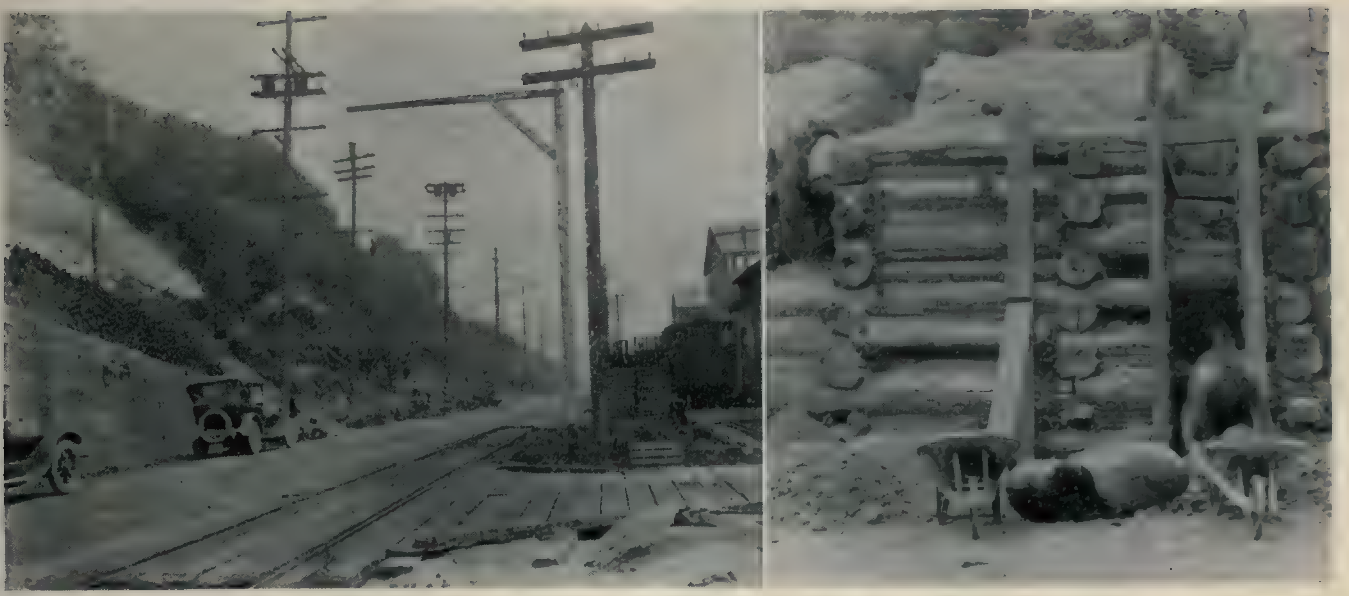
Mr. Ritchie, replying to the above and other discussion stated that with regard to expansion joints, he had been much troubled in the past on the matter of contraction, because, as Mr. Storr had said, concrete behaved in a very peculiar and apparently inconsistent manner. In one case they would have concrete cast under certain conditions which would not crack in a length of 30 ft. to 40 ft. or more, whereas in another case under very similar conditions it would crack in a length of 20 ft. Much depended upon the amount of water used in the concrete, and that was a thing which was a little difficult to control in practical construction. Disposition to crack also depended largely on the temperature and the weather conditions during setting and maturing. It was the result of a tensile stress set up in the concrete by a reduction of its bulk, and the greater the percentage of water used in the concrete the greater the shrinkage on setting. He had had a fair amount of experience in the design and construction of warehouses and factories in reinforced concrete, and it was extremely rare that the floors in a building of any appreciable length did not develop cracks about every 20 ft. As a rule, warehouse floors were divided into bays, varying from, say, 17 ft. to 25 ft., being the span of the main beams on to the columns. A position half way between the supports was the usual position in which to stop off the concreting operation at night, ready to commence on the following morning, and it was always in that position that the cracks developed. Shrinkage was going on over a long length, and where there was no tensile resistance—namely, at these planes of stoppage—the thing opened out. Replying to one member, as to whether there was any slip between the concrete and the steel, he believed there must be a slight movement of the concrete along the bars during the early part of the process of setting, but thereafter there was initial compression set up in the steel reinforcement, and generally speaking he did not think any slip actually took place after the final setting of the concrete, provided that too high a percentage of reinforcement was not employed. Cracks and their behaviour were rather difficult to explain, but where they occurred there was probably a slight slip between the steel and the concrete for a very short distance on each side of the crack. Where a crack occurred the structural section was changed from a composite section of steel and concrete acting together, to the simple steel section crossing the crack, and at this point the stress on the reinforcement was consequently intensified and extension takes place. He believed this brief explanation replied to the question raised as to the action of the expansion joints which virtually were cracks in the concrete in predetermined positions.

Mr. Ritchie said he could remember reservoirs constructed only twelve years ago in reinforced concrete which were anything but watertight. The point was that the stresses originally allowed in reinforced concrete reservoirs were far too high, and in the cases he had in mind the allowable tensile stress in the steel was taken at 16,000 lb. per sq. in., or even higher. It must be remembered that a tank to hold water actually got the full load for which it was designed, and, therefore, any deficiency in design showed itself more readily than in the case of, say, mill or factory floor construction, where the floors were designed to carry loads in excess of those which they would actually be called upon to bear. Those floors were nearly always satisfactory in practice, whereas there was nearly always trouble with the roof where such was formed as a tank, until reduced stresses were adopted. Any deficiencies or defects in the design were always shown in such roofs where they got the actual load for which they were designed.

The Government Conversion Scheme

The attention of the holders of the Canadian five and a half per cent war loan bonds maturing December, 1922, is directed to the offer of the Minister of Finance to renew the loan. The last Canadian loan was placed in New York but the Minister is making his present financial operation entirely a domestic one by offering to accept the maturing bonds in exchange for new bonds bearing the same rate of interest, running for either five years or ten years as the bondholder may prefer. A further inducement to the investor is that he receives a bonus of one month's interest. The only difference is that the new loan is not tax free. The terms offered are favorable to the investor and doubtless a large part of the maturing loan will be renewed. Arrangements for the exchange of the bonds can be made at any branch of any chartered bank. Holders who do not wish to reinvest will be paid in cash on the 1st of December.

For the first time since 1917 American roads have granted reduced fares to the Canadian National Exhibition.



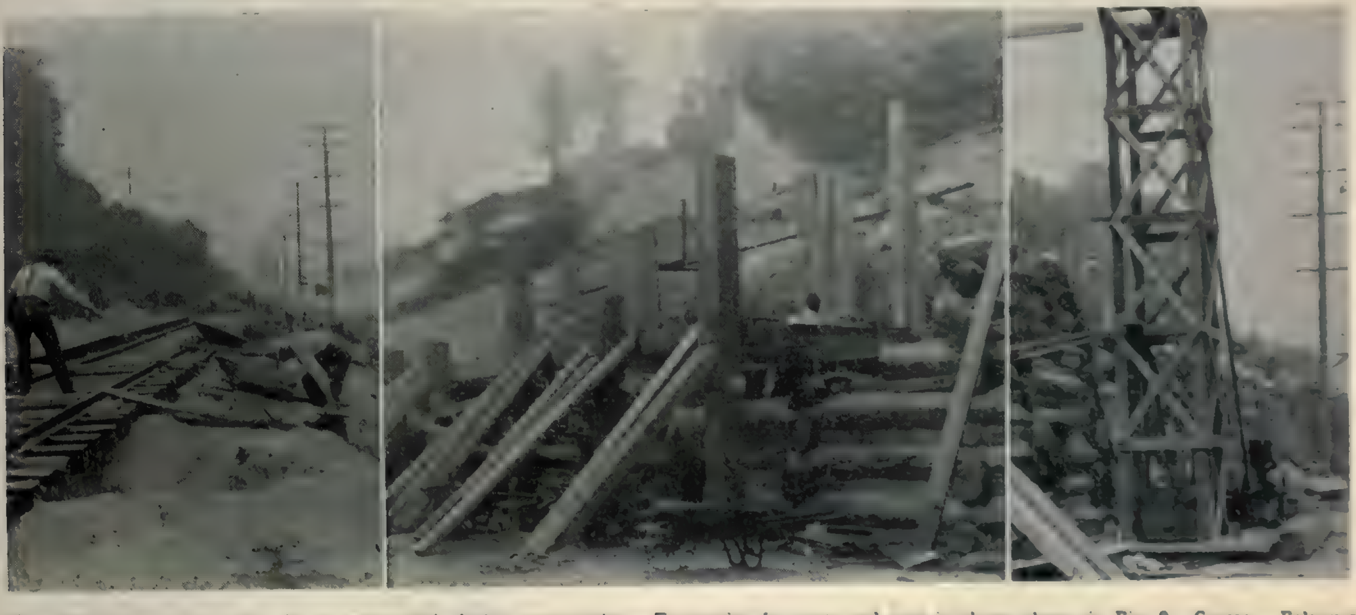
Retaining Wall Construction at New Westminster, B.C.
Left; General view, at commencement showing narrow working spaces between lower track and wall. Right: Showing chases cut in old crib work to permit introduction of falsework

A Difficult Retaining Wall Job

Replacement of Crib Wall by Concrete Along Railroad Tracks at New Westminster, B. C., Involves Some Special Methods —Traffic Has to be Maintained

A retaining wall job involving difficult construction problems has been awarded by the Provincial Department of Railways to Robertson & Rendell, Ltd., contractors, of Vancouver, B. C. The work is at New Westminster, B. C., and is one of the subsidiary works to the provincial bridge across the Fraser River, which connects the provincial highway system and the transcontinental railways with the corresponding systems in the states to the south, as well as giving access to the whole of the Fraser valley farming sections.

Up to the present this wall has been in the form of a timber crib, but this contract is for the replacement of the existing cribs with concrete. The work is expected to cost in the neighborhood of $47,764, as far as the contract items are concerned, but owing to the necessity of maintaining traffic on the main line track which is protected by the wall during the construction period, a good deal of work will be done on force account in connection with false work and extra excavation. The contractors expect to have the job complete some time during October of this year, and have already completed about 150 feet of wall



Left: Stringer in place under ties to carry track during construction. Excavating for posts and caps in chases shown in Fig. 2. Centre: Falsework to carry stress across site of wall of the road and make upper track secure for continuous traffic. Right: Special concrete tower designed for working in constricted place where the section is low and false-work not required.

The prices tendered by the successful firm are as follows: Concrete (main wall) $10.73, (short wall) $11.12, excavation $0.97, renewing portions of log crib per ft. $0.81, backfill $0.80, tile drains in place $0.35 per ft. Forms are included, of course, in the price for concrete.

As for nearly the entire length of the work the wall is close underneath a main line track, on which traffic cannot be interrupted, special arrangements have had to be made for safely supporting the track and the earth forming the embankment, which is nearly all made ground and consequently slides very easily. The general system adopted has been the insertion of temporary stringers beneath the ties, in units about thirty feet in length. These will be supported in turn by caps pushed right under the whole track, supported at the inner end by blocking, and at the outer end by posts from the level to the lower road.

To enable these caps and posts to be placed, narrow chases are being cut through the existing cribs, and the material excavated far enough back to clear false work and the concrete wall to be built. A frame work of 12" x 12" timbers is then built up, with braces down to the road surface, and the inner timbers carrying the sheating which is of 3" x 10" timber. Modifications of this general system will be adopted at different portions of the length of the work, to suit the conditions which may be found as the work is opened up.

Special Concreting Arrangements

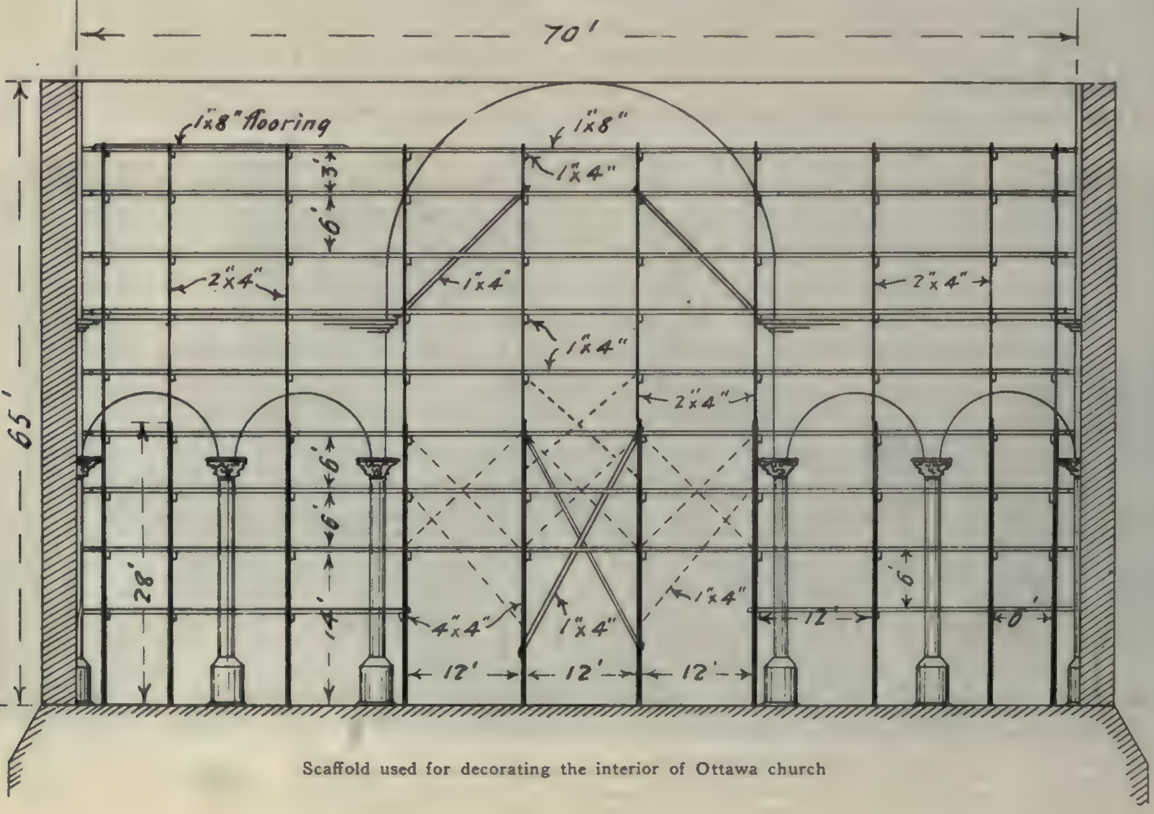
Owing to the narrow space available for working, between the face of the wall and the lower track, as the road must also be kept open for motor and general wheeled traffic, special arrangements have been necessary to provide for concreting. A specially designed compact elevating tower has been built, with a 6 cu. ft. bucket which is arranged to dump at any desired height from about 7 feet to the top of the tower, which is of sufficient height to provide for the highest section of the wall. A gasoline engine hoist has been arranged in connection with this, and the whole has been placed on skids, so as to follow the work without loss of time.

Scaffold of Light Design

Used in the Decoration of the Sacred Heart Church, Ottawa

By A. LANGLOIS, B.A.Sc.

The directors of the Sacred Heart Church, Ottawa, Ont., are at present having the interior of their church entirely decorated. An interesting feature in connection with this work is the very light scaffolding used. The total height between the floor and the ceiling is 65 feet, the other dimensions being, length 160 feet and width through the transept 70 feet. The amount of lumber necessary for the work is 29,000 feet b.m. and clear spruce only is used. The accompanying drawing is a section across the church at the transept. The vertical uprights throughout the work are 2 x 4 inch pieces except for a distance of 42 feet from the base where there are two pieces nailed together making the verticals 4 in. by 4 in. for that height. The uprights are placed 12 feet apart both ways and held by 1 in. by 4 in. horizontal pieces running in both directions as shown, the lowest being 14 feet from the floor, the balance being put on at six feet intervals. The floor is made of 1 in. by 8 in. planks with a 3 inch space between them and is supported by 1 in. by 8 in. cross pieces resting in turn on the 1 in. by 4 in. horizontals. There is practically no bracing of the structure besides, of course, the horizontal pieces which are all abutting against the walls and columns; there are only three sets of braces for the entire length of the centre



Scaffold used for decorating the interior of Ottawa church space, and only two sets in each of the adjoining spaces. All braces are 1 in. by 4 in. pieces secured in place by 3 in. nails.

The reason for using as light a structure of this kind as possible is to prevent vibrations which are very much accentuated in a heavy scaffold, to such an extent as to make accurate work by the painters impossible.

It is expected that between 5,000 and 6,000 pounds of paint will be required for the work which will include all walls, ceiling panels and columns, and will cost in the neighborhood of $15,000.

Mr. L. E. Monty of Montreal is in charge of the work which is being done on the percentage basis.

Oxygen Producers Consolidate

The consolidation recently of the manufacturing and distributing resources of the Dominion Oxygen Company, Limited, and the National Electro Products, Limited, gives to Canada one of the largest organizations of its kind on the continent. The business is henceforth to be conducted under the name of the Dominion Oxygen Company, Limited, now operating oxygen plants at Montreal and Toronto, and acetylene plants at Merritton, Winnipeg and Shawinigan Falls. In addition the company conducts oxygen and acetylene distributing stations at Hamilton, Windsor and Quebec. It is claimed that the union of the two companies will be of material advantage to all Canadian oxygen users through stabilization of the product, assurance of steady supply and certain improvements in service that enlarged facilities will make possible. It is understood that Mr. W. J. Cluff and associates, of Toronto and Montreal, who founded the National Electro Products, Limited, several years ago, will retain their relationship with the oxygen industry through their interest in the consolidated companies.

The Toronto and District Master Plasterer's Association

On July 4 last, the master plasterers of the city of Toronto and the surrounding districts, who are concerned mostly with the plastering of residences, met together and after some discussion, decided to form an association known as the Toronto and District Master Plasterers' Association, whose object should be the betterment of the plastering industry in general. The following were elected as officers to conduct the business of the association for the balance of the year 1922: President, J. Lennox; vice-president, Ben Wright; treasurer, H. H. Bremner; secretary, A. E. Flower; assistant secretary, Miles Gaunt.

The association which has at present a membership of 30, meets every other Tuesday at 8:00 p.m. at 2 Berti St., Toronto, and all employing plasterers who have the welfare of the industry at heart, are invited to attend these meetings and give their support to the officers in their endeavour to promote the object for which the association was formed.

Sewer Has Long Life

In October 1920 the town of Simcoe, Ontario in extending its sewage system found it necessary to lower an extending sewer on King Street, which had been laid in 1890. In locating this sewer one pipe was broken but the remaining 398 feet was carefully taken up and found to be in such perfect condition after thirty years service that it was all relaid.

The Part of Paint in the Campaign Against Waste

An address by Ernest T. Trigg, president of the National Federation of Construction Industries

The intelligent and far-seeing work which the industry has done during recent years, in educating the public to the economic value of paint and varnish, is serving a most useful purpose. There is no longer the necessity for debate on the subject with thoughtful people. Recognition of the importance of paint and varnish in property conservation has been given in the freest and most practical way by not only private property owners but by substantially all our large industrial corporations, by public utilities, transportation companies, ship owners and operators, by our various municipalities and state and national government.

By all of these, our national government included, the specifications for new construction contain just as complete instructions covering the paint and varnish requirements as for any other element entering into them. Not only does this apply to new construction, but it is a regular part of the programme of up-keep that such construction shall, with sufficient frequency, be repainted and revarnished. This is done, not for the primary purpose of appearance or decoration, but for the more fundamental and thrifty purpose of protecting such property from decay and rust and thereby prolonging its life many fold. While referring to this fundamental function which we, in the industry, and a large percentage of the public, fully appreciate, I do not wish to slight or overlook the very great value to the public in its frequent use of paint and varnish products from the standpoint of decoration or appearance, or pride, no matter what term we use.

I believe it is a fact that while the use of paint and varnish from a preservative standpoint has a tangible asset value, its use from the standpoint of appearance or justifiable pride has also a very great intangible value which cannot always be measured in dollars and cents. Without a doubt it enhances property values in the event of a desire to sell; it gives to local trades people and bankers greater confidence in the character of the property owner; it elevates the property owner and his family in the minds of others in the community and gives him and his children a better standing; it makes the property owner a better citizen, one who is more useful to himself and his community. At the risk of being considered too great an advocate of the frequent use of paint and varnish, I want to take this opportunity of suggesting that just as the property owner who keeps his property in excellent paint repair is an asset to his community, so is the property owner who allows his property to deteriorate, decay and gradually rot away, a liability.

In saying this, I am not unmindful of the property rights bestowed upon individuals by our constitution, but I wonder if, without discussing legalities but thinking only in terms of moral rights,—if we haven't passed the stage of individualism which once existed and if, after all, there are not certain things which we owe to the community in which we live, the performance of which is essential to our proper community character There are many unwritten rules which we all follow in our conduct with our fellow men,—why should not the community code ethics under which we live recognize the fact that it is a waste of wealth to the community for property to be neglected in its paint repair, and that such property,—a house, if you please—made untenantable because of lack of paint attention, is depriving someone of the use of that property and hence is to the detriment of the public? I wonder, too, if we should not all be mindful of the fact that property well taken care of not only is of greater value itself, but its greater value is reflected to surrounding properties, while neglected buildings in like manner depreciate the value af adjacent properties? It is a fact that community-life rules recognize this principle in many directions. For instance,—in some sections of the country communities will not permit orchards to be abandoned.

The principle back of this is that they should be made to produce food required by the public, and, therefore, their neglect and abandonment is detrimental to the public welfare and will not be tolerated. Let us hope that the day is not far distane when the owner of property who neglects it and thereby fails to make it serve the useful purpose for which it was intended and at the same time depreciates the value of his neighbor's property, will be considered an undesirable citizen and a social outcast with whom other citizens do not care to associate. No one is more desirous of keeping alive the opportunity for individual initiative and its pust reward than am I, and I am sure that what I have just said could not possibly be misinterpreted to suggest any limitation of such initiative.

My whole thought in this connection has to do with the encouragement of each individual in a community to recognize his importance and responsibility to everyone else located in it. I am placing great emphasis on the public side of our position becaues after all it is only out of a proper discharge of our responsibility to the public that, as an industry, we shall realize on the great opportunities before us. I am convinced that to be successful as individual units of the industry and to be successful as a whole industry, we must carefully measure all of ouractions in terms of the public welfare.

Anything Which is not Good for the Public is not Good for us

I have referred to the great opportunities before us. Surely, there is no thinking person in the industry who does not realize that we have so far just about scratched the surface of our possibilities. On every side, we see daily a crying need for more of the products of our industry to protect and preserve surfaces of all kinds. I sometimes wonder what men in other industries must think of the paint and varnish manufacturers of this country when they realize how relatively little of the possibilities for business which exist is being realized on. We, in our industry, certainly should know more about the economic value of the use of our products than anyone else, and I feel that continued failure on our part to **enlighten the public as to their interest,** is a reflection upon the good faith of the industry and an evidence of failure to serve where service is required.

In the constructional activity section of the Contract Record of July 19, page 58, it was stated that the estimated cost of new incinerator for the city of Chatham, Ont., was $85,000. This figure was published in error, the engineer's estimate being, as a matter of fact, $31,000.

Warehouse in North Battleford

Mr. R. E. Wayte, of North Battleford, Sask., has just been awarded the contract for demolishing the warehouse of MacDonald & Crawford, Wholesale Grocers, of Old Battleford, Sask., and to erect a new solid brick warehouse at North Battleford, consisting of 2 stories and concrete basement, 50 x 100 feet, at an estimated cost of $20,000. Practically all materials from the old warehouse, will be used in the erection of the new building. Mr. Wayte received the contract 10 years ago to erect the old warehouse in Old Battleford.

Canada's Fire Loss

For the first six months in 1922 fire losses in Canada amounted to $20,000,000. We have the unenviable record of the highest fire loss per capita in the world. A large percentage of this loss is buildings. What better argument could we have for urging only the safest, most substantial and most fireproof type of construction?

Don't let us run away with the idea that the insurance companies bear this loss. We who pay the premiums bear it—every cent. Every man, woman and child contributes a dollar and a quarter every three months. And this does not include the cost of fighting fires. Is'nt it an expensive luxury?

Despite the railroad strike across the line Managing Director Kent of the Canadian National Exhibition predicts a record attendance. He believes the large crop and early harvest through Ontario will make up for any deficiency in American tourist traffic.

Holes in Plaster

Cracks or holes in plaster are frequently seen in basements. They may be due to various causes, but regardless of what caused them their effect is bad. The owner of a building, or the tenant may not consider the damage of sufficient importance to justify calling in a plasterer, but the insurance companies may think differently. Recently an advertisement of an insurance brokerage firm appeared in the New York Times to the effect that an inspection of a building showed some plaster defects in the basement. They recommended that the plaster be repaired in order to reduce the insurance premium. This was done, and while the repairs cost only $3.75, the saving in the insurance premium was $65.

Plastering by the Ancients

William Millar, who examined fragments of early Egyptian plaster and stucco, found that its base was lime, and that it was practically three-coat work. It was about three-quarters of an inch thick, haired and finished as is done now. When used on partitions, it was laid on reeds which were laced together with cords to serve as lathing. The ancient Greeks made extensive use of lime stucco, one rather famous example, the Temple of Apollo at Bassae, dating back to 500 B. C. The Romans and Moors carried lime stucco to a high state and many structures are still extant which serve as silent witnesses to the durability of lime **stucco.**

The Contract Record's

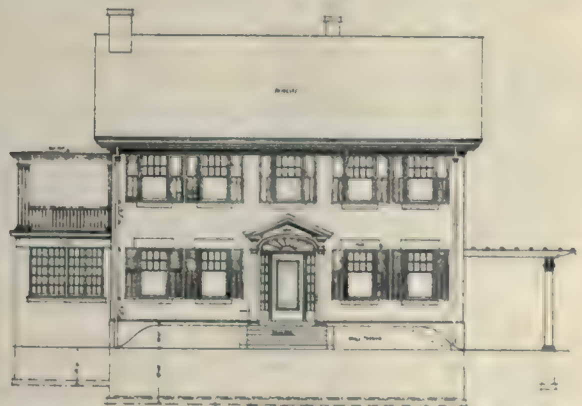
Weekly House Suggestion No. 32

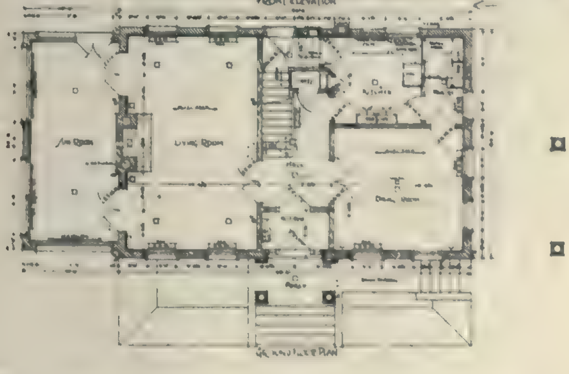
The Colonial type residence we illustrate this week was designed bv Mr. E. Telfer Arnoldi, architect, Confederation Life Bldg., Toronto, and will be constructed shortly in that city. The general construction will be of red face brick, with stone trim, and the roofing will be of wooden shingles. There will be a narrow brick terrace along the front of the house, with steps at the right end. The handsome entrance porch at the front will be carried out entirely in wood, enamelled white. It is the prominent factor in the exterior beauty of this design. This entrance is on a roomy vestibule, which in turn opens on the hall, in which is located the staircase and cloakroom. The large living room to the left, which is entered from the hall through double doors, runs the full width of the house, as seen on the plan, and has two entrances on the sunroom. In the wall between these two doorways will be located a handsome brick fireplace, with red tile base. The sunroom also runs the full width of the house, but is so designed that it may be divided in the centre at any time, should it be necessary to create another room. There is an entrance from the outside on the sunroom at the rear. To the right will be situated the dining room, kitchen and pantry, with a handy swinging door connecting the former and the latter, as seen on floor plan. The kitchen and pantry arrangement is well planned and these rooms will be equipped with many up-to-date and labor saving features, including a built-in refrigerator in the pantry, with provision for icing from the outside, dressers, metal lined clothes chute, etc. There is an entrance from the rear on the landing of the cellar staircase.

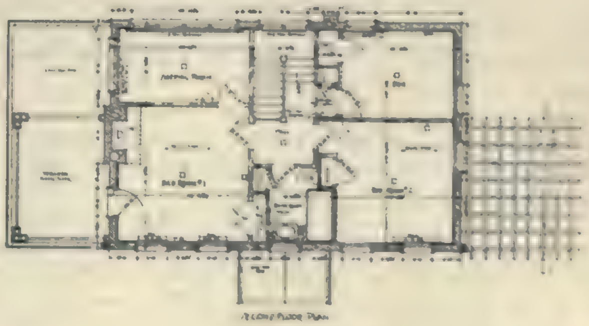
Oak floors will be laid throughout the house, with birch trim down stairs and pine white enamelled upstairs. The staircase will be of birch.

There are two bedrooms, den, sleeping porch and bathroom on the second floor. The main bedroom will be equipped with simple brick fireplace and will have entrances on the verandah over the sunroom and sleeping porch at the rear. The bathroom on this floor will be finished with tile floor and walls to a height of about 4 feet 6 inches. There is an unfinished attic above which is large enough to accommodate two bedrooms and bathroom and a staircase could very easily be built in the hall, should this extra space be required.

The basement is under the entire area of the house and is subdivided in plan into boiler room, coal storage space, laundry, work room and larder. A small gas burning garbage incinerator will be installed in the basement.







The new Coliseum which will be used for the first time by the Canadian National Exhibition this year has 8½ acres under roof. The judging ring, which is larger than Madison Square Garden, has seating accommodation for 7,600 people.

Mainly Constructional

East and West—From Coast to Coast

Mr. Arch. Davidson, 1 Burnside Place, Ottawa, contractor and builder, has now under construction 12 detached brick residences in that city.

The new 500-ft. St. Stanislas Bridge over the Batiscan River, which opens a new road for traffic between Quebec and Montreal, was opened about two weeks ago. The bridge cost $80,000 to construct.

The old established firm of Alex. McArthur & Co. Ltd., of Montreal, manufacturers of tarred felt roofing, building paper and similar lines, has sold out to the Barrett Company, according to a recent report. The firm operated a paper mill at Joliette, P. Q., as well as the plant at Montreal and was a pioneer in Canada in the manufacture of the above lines.

A recent report states that contracts have been awarded for the excavation of 80,000 yards on river front property at Petite Cote, near Windsor, Ont., as the first step in the development of a pleasure park. There is an excellent bathing beach at this point and preliminary plans provide for the cutting of a deep channel through the beach to accommodate ferry boats. Messrs, Abbott & Gray, building contractors of Windsor are the owners of this property.

According to present plans, construction work on the twenty-two storey central tower in the new Chateau Frontenac addition, at Quebec, will not be continued throughout the present winter. It is stated that exterior work will be completed to the twelfth storey and the men will be employed on the interior during the winter months, which work will provide employment at a time when it is needed.

The Ford Motor Car Company of Canada has presented to the town of Ford about half a mile of frontage on Sandwich St., as the company's share towards the establishment of the long cherished 100 ft. driveway throughout the Border cities, along the Detroit River.

The Building Laborers' Union, at Toronto, held a special meeting recently to draft a resolution to be forwarded to the Trades and Labor Congress, the Provincial Government and civic authorities, drawing attention to the danger to life because of faulty equipment and urging the appointment of inspectors of derricks and equipment. The Deputy Minister of Labor, Mr. J. H. H. Ballantyne is bringing the matter to the attention of the Minister, with a view to having the present Building Trades Inspection Act altered to enforce this inspection.

The official opening of the new Pure Food building, at the Toronto Exhibition, will take place on August 25. This building is a handsome structure of buff brick, with artificial stone trim, and contains six open air courts, and although it contains about 27,000 ft. of exhibit area, it will only accommodate about two-thirds of the demands for space this year. An addition is planned, to add nearly 200 ft. to the length of the building.

Another convention of the boosters for the Windsor-Goderich scenic highway is planned to be held in Sarnia, Ont., towards the end of this month. The Department of Highways has been presented with a resolution petitioning the taking over of the roads necessary for the establishment of this highway and interesting developments are anticipated shortly.

It is probable that a start will be made on the new Queen's University Library at Kingston, Ont., next month. This structure will entail an expenditure in the neighborhood of $225,000.

The city council at Kingston, Ont., have recently voted a further sum of $25,000 towards the construction of a contagious diseases building in connection with the General Hospital there, the original estimate being $150,000, or $25,000 less than the lowest figure tendered.

A site has been secured by the Mystic Shriners at Montreal for the erection of a hospital for crippled children. This building will be erected on Cedar Avenue, adjoining the site of the Children's Memorial Hospital, the existing residence by-law restricting building in this section of the city having been altered to permit of its construction. It is roughly estimated that the building will cost about $150,000 and will provide accommodation for 50 beds.

Personal

Hon. Dr. J. H. King, minister of public works, Ottawa, along with Messrs. A. St. Laurent, chief engineer of the department; J. M. Wilson, district engineer and Col. Lamb, superintendent of engineering were the guests of the Toronto Harbor Commission at a luncheon recently, held at the Royal Canadian Yacht Club.

Mr. J. G. G. Kerry, of the consulting engineering firm of Kerry & Chace, Toronto, will go to Vancouver to report on sites near the city suitable for the establishment of a hydro-electric plant, according to a recent announcement.

Mr. W. R. Graham, Lansdowne, Ont., has the agency for the St. Mary's Cement Company, manufacturing cement blocks, cement well tile and Culbert cement tile.

Messrs. R. E. Beatty and S. Prenter have been appointed to the Vancouver Harbor Board, succeeding Messrs. MacKie and MacKenzie, who resigned recently.

J. Wardle Bulcock, A.R.I.B.A., of Toronto, for some time chief draughtsman in the offices of the late J. Wilson Gray, O.A.A., M.A.A., architect of that city, has accepted the position as estimator and cost clerk with the firm of E. J. Curry, contracting plasterer, York Building, King and York Streets, Toronto.

Obituary

We regret to announce the death of John Mattson, a pioneer builder of Winnipeg, who died at his residence on July 28th. Mr. Mattson, who was well known in western building circles, had been a resident of Winnipeg for the past 30 years, and from 1902 to 1906 was proprietor of the John Mattson Sash and Door Co. During his career in Winnipeg, more than 300 houses were erected under his supervision. He was president of the "Swedish Canada" newspaper and one of the founders of the Norden Sick and Benefit Society. He is survived by his widow, four sons and two daughters.

Trade Incorporations

Alex. McKay Co. Ltd., with head office at Toronto, capital $40,000, to deal in builders' supplies, etc.

Galbraith-Macdonald Co. Ltd., 2 St. Clair Ave. W., Toronto, have been incorporated with capital $40,000 to conduct business of general contractors, etc.

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director

HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL	119 Board of Trade Bldg.
WINNIPEG	302 Travellers' Bldg.
VANCOUVER	Winch Building
NEW YORK	296 Broadway
CHICAGO	14 West Washington St.
LONDON, ENG.	16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U.S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, August 30, 1922 No. 35

Unbusinesslike Tactics

The Contract Record feels that it is justified in issuing a word of warning regarding the apparent trend of the building industry at the present moment. An onlooker, outside, looking in, often sees things that those who are in the very thick of the struggle overlook. For that reason we take the liberty of expressing an opinion that may not meet with approval and yet, we believe, is sound and in the best interests of the construction industry.

The present season has been one of fair activity. This activity was induced partly by the demand for new buildings,—especially houses,—partly by concessions in material prices made by jobbers and manufacturers. The public was carefully nursed into the attitude of mind where they believed they would get value for their money. This latter was the important factor in the whole situation,—the confidence of the public.

Just as soon as work gets nicely under way, however, what happens? Prices of materials begin to stiffen; rumours of shortages arise; people are urged to build quickly before conditions become more unfavorable. This has made the public suspicious—they do not stop to analyze basic conditions. Today they are losing their confidence: saying that it would be better to wait. The coal situation is also undoubtedly having its effect on building. "Why build a house" one man said recently "if I can't get coal to heat it?"

Under the circumstances the Contract Record feels that though temporary conditions of supply and demand may justify an increase in prices of materials, still, it is poor business. It is also poor business to broadcast the impression that materials are scarce. The public has not reached the stage where they can be either coerced or frightened into building. The process for some time must be one of coaxing. The situation must be handled with infinite tact or we shall drop back this Fall into a condition of inactivity and unemployment.

And all that has been said as regards the prices of materials applies equally to Labor. Workmen will be consulting their own interests if they will do a real day's work every day and at the same time withhold their claims for higher wages. So far as the building public is concerned Labor is on trial this summer. People are watching to see whether a period of unemployment and other adverse conditions has convinced Labor of the advisability of doing real honest work when they have a chance. There is a certain amount of both slacking and discontent in evidence but the public is not in a mood to show the least sympathy for either.

Looking at the whole situation by and large, therefore, would it not be better to watch the pulse of public opinion with exceeding care for a few more months, make every reasonable concession in the way of prices, show a greater confidence in our ability to supply all requirements, and in general, try and further the impression in the mind of the man who wants to build that, "the industry" will take care of him.

The other day a man walked into his coal dealer's office to have a chat about his winter's supply. The dealer had no coal and no prospects, but he assured his customer that, "We'll take care of you some way," and the man went out satisfied. On the same day another man tried to buy brick to build a house. He was told, "Bricks are scarce articles and the price is up. Can't deliver them in less than six weeks." This man is now urging his wife to give up the idea of a house of her own just yet,— he's quite discouraged.

What a difference! And the coal situation is a dozen times more serious, too.

Training to Think vs Gathering Information

A coast engineer writes us regarding the growing change in the viewpoint on engineering education among those best qualified to judge which was very noticeable at the recent Vancouver convention of electrical engineers. A substantial proportion of the addresses presented dealt with various aspects of the profession and the problems that arise in this connection, notable among which was the paper by T. Milton of the Electric Storage Battery Company, who took for his subject "Training to Think versus Gathering Information."

The profession of engineering, of all callings, might be pardoned for the assumption that the important object of the education of the youths growing into "the game" is the storing of their minds with as much as possible of the information which has been amassed in the field of practical science during the many years in which their predecessors have been working experimentally, trying, proving, failing and trying again. In many lines this process has gone so far that it would seem sometimes that there is little but facts left to learn—that all that is required is the correct and careful application of rules and details which have become thoroughly fixed, and of which the ordinary engineer in practice knows little concerning the origin or fundamental principles. So much has been done for us; text books and books of tables, with their diagrams and formulae for almost every conceivable need are so easily obtainable, and cover such a diversity of needs that there is, in ordinary every day practice, little apparent need for anything but a good memory for information.

The plea of the address to which reference is made was that far more effort should be expended on teaching the habit of thought than on the impartation of a vast fund of information—that, in short, the ideal of education is that the mind should be trained to think and originate, rather than stored with facts. This view does not detract from the value of a thorough training in the fundamentals—the mathematics and physics which are the tools of the originating mind—in fact it emphasizes those things and demands that upon these the main emphasis of an engineer's education belongs.

The paper also dealt with the subject of specialization to some extent. It has been customary to suppose that specialization during a college course would tend to narrowness of viewpoint, and act as a limiting factor to the student's scope in after life. Mr. Milton does not think so, and cites instances that go to prove that the superior agility of mind which is the result of prolonged study for the mastery of even a single subject, gives a tremendous advantage over those whose energies have been dissipated in acquiring a mere fund of facts.

This is somewhat radical, no doubt, but no very keen observation is required to see that something is really lacking in the training of engineers as a whole. There is a quality which may be variously described as vision, or initiative, or originality, without exhausting its meaning, and which is not by any means possessed by members of the calling to the extent that might fairly be expected. And it is this lack which is responsible in part at least for the fact that the profession has not the influential position as yet in the affairs of communities and the nation to which its members feel their training entitles them. A careful study of the individuals in the profession who have reached such places of influence and responsibility shows them to be conspicuously in possession of qualifications other than those obtainable from the study of books.

Model Road Near Chicago

Some new ideas in road building and equipment are to be embodied in a restricted section of the Lincoln Highway, near Chicago, as a model for future construction. The Lincoln Highway Association sent out 4,000 questionnaires to highway engineers, college professors interested in the work, and landscape engineers, asking for suggestions. From the volume of advice thus obtained a model section has been planned. It will be one and a half miles in length, 32 miles south of Chicago. The section is to be 100 feet in width, affording ample room for four lanes of travel, an average traffic of 15,000 passenger automobiles every 24 hours. The speed limit will be 35 miles an hour. There also will be accommodation for 5,000 motor trucks at 10 miles an hour. A pavement 40 inches in width will be provided for foot passengers.

The show place on the highway will be paved with concrete to a thickness of 10 inches. It is to be scientifically drained, the courses being submerged. There is much difference of opinion among engineers as to the plan of lighting the highway at night, but it has been determined to light this part adequately. Throughout the section there will be no grade crossing. All wires crossing it will be carried under ground.

The section is to be laid out as nearly straight as possible. No curve will be permitted with a radius of less than 1,000 feet. The section, which is to serve as a model for the rest of the highway and of roads in general, will have no advertising signs displayed along its borders.

There will be adequate signs giving direction along this section, and these will in turn be carefully designed and standardized. It also is planned to establish camp sites for motorists. These will be supplied in turn with shelters, running water and equipment for cooking, after the best models.

Paving Brick Standardization

The National Paving Brick Manufacturers Association, after years of effort to standardize an accepted list of sizes of paving brick, which sizes were approved by the manufacturers, finally enlisted the support of the Bureau of Standards and the Department of Commerce with the result that a reduction was made from sixty-six sizes and varieties of paving brick to eleven. An even more simplified list of sizes of bricks is being worked out whereby it is hoped that these eleven sizes may be reduced to three.

Proposed Development of Montreal Harbor

The official sanction of Hon. Ernest Lapointe, Minister of Marine & Fisheries, has been given to the Montreal Harbor Commission's extensive programme of improvements to the port of Montreal, and a start will be made immediately on several of the projects.

The programme involves the expenditure of nearly four and a half million dollars and the present plans of the Harbor Commission as announced recently, embrace the following works: Construction of a new grain elevator at Tarte pier, to have an initial capacity of two million bushels, that will ultimately be increased to eight million, and to cost approximately $2,347,000 for the first unit constructed; the preparation of designs for the proposed new bridge across the harbor at a cost of $50,000, (the ultimate cost of the bridge itself, it is said will be in the neighborhood of $10,000,000); extension of the high level quay walls between sections 25 and 35 at cost of approximately $475,000; extension of the wharf at the Imperial Company's plant by 500 feet at cost of $250,000; the extension of Jacques Cartier pier, $200,000; extension of Alexandra pier, $400,000; the extension of King Edward pier, $450,000; improvement of the channel approach to Bickerdike pier, $97,849.65, and the paving and extension of the harbor railway terminals to the new wharf levels east of section 25, at cost of approximately $50,000. The total cost of the various works is estimated at $4,319,849.65, to be provided out of the new loan of $5,000,000 recently made to the commissioners by the Government.

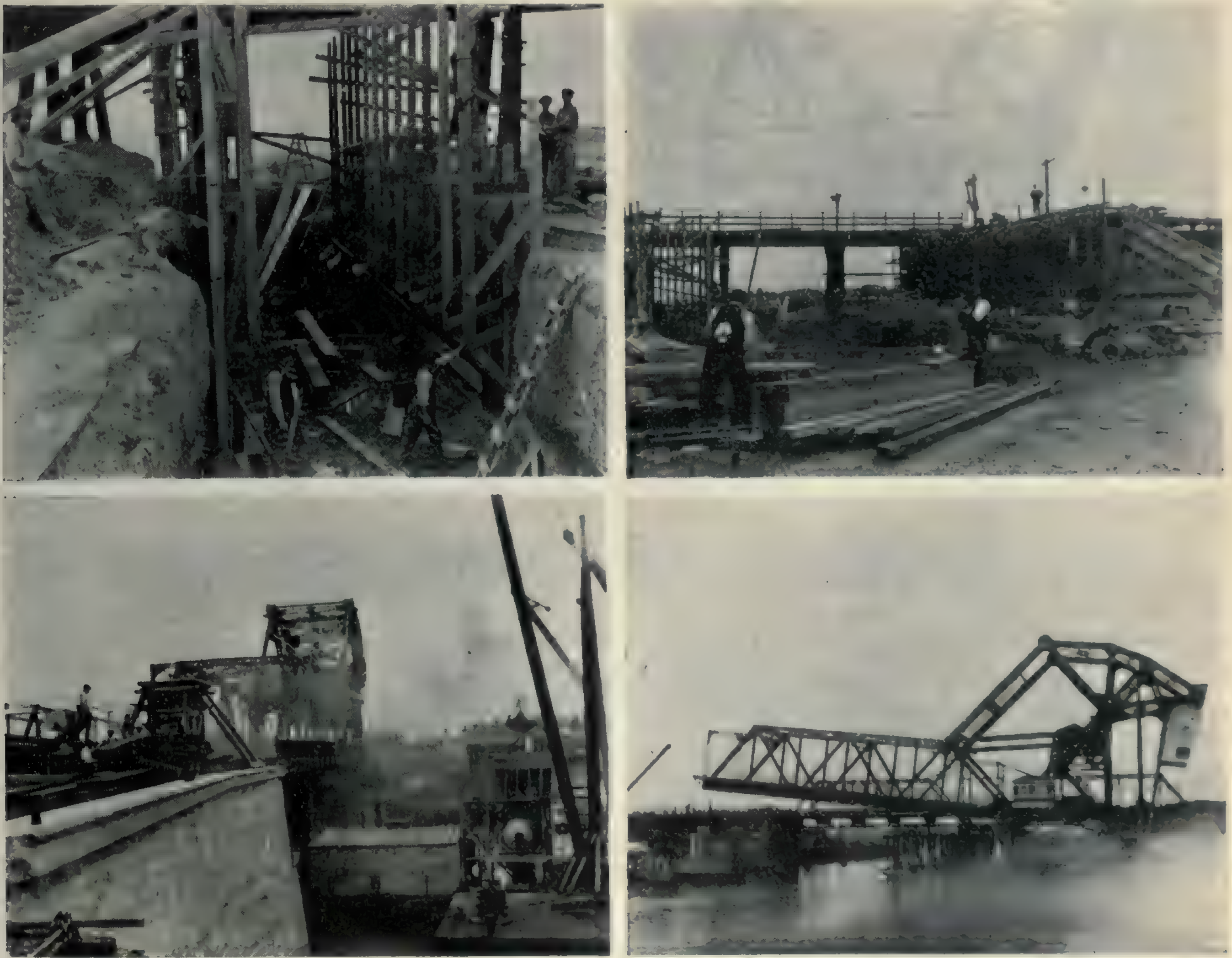
Progress on Johnson St. Bridge, Victoria

Highway Span Successfully Placed — Removal of Swing Span Commenced — Economical Handling of Material for Subway Structure

On the afternoon of the 14th of August the recently completed highway section of the Johnson Street Bridge scheme at Victoria, B. C. was lowered for the first time, moving into place exactly true to line and distance. This satisfactory conclusion to many months of anxious and careful work is looked upon as auguring equal satisfaction from the remaining units of the scheme, which will now be proceeded with.

An interesting feature of this first trial was the extreme accuracy of the estimated weight required as a counterweight. The weight, which is of concrete, and which has only recently been completed by Messrs Parfitt Bros, the sub-contractors for this portion of the work, proved to be very slightly on the heavy side with the bridge in its present condition, considerable work in connection with the deck still being required, and when this work is completed it is probable that some additional weight may be required to obtain a balance. Under the existing conditions however, it was found that 160 amperes of current were required for lowering, and 150 amperes for raising, which was regarded as a very close result for a preliminary trial.

Work will now be commenced on the removal of the present swing span, which is still in use by the railway, but which will be permanently out of commission as soon as a temporary trestle is completed which will divert the railway traffic for the time being over the highway section of the new bridge. It is anticipated that this work will take about two months in all. About another four months will then be required for the completion of the substructure. The work remaining to be done on the piers consists of the completion of the main or trunnion pier, a portion of which was necessarily left for construction



(Upper left) Placing form for subway abutment. (Upper right) General view: framing and placing forms for abutment of subway crossing, west approach. (Lower left) Concreting plant in use for supplying concrete to subway abutments, west approach. Main bridge in lowered position. (Lower right) Bridge bascule being lowered into place for first time.

until the cylinder piers of the old bridge are removed.

The northern half of the eastern abutment has also been left and will be proceeded with as soon as conditions permit. The rest pier and west abutment with its wingwalls are complete, and considerable progress has been made on the earth filling for both approaches, the material for the western end being obtained from the grading of the extension of Johnson Street to connect with the new bridge, which is being carried out simultaneously by a separate contract.

Work is at the present time proceeding on the construction of a subway in connection with the scheme, which will make the connection between the extension of Johnson Street which has been referred to and the west end of the bridge. This subway, which is being constructed with concrete abutments and wingwalls will furnish an elevated crossing for the railroad over the new highway, and will be spanned by steel girders of standard railway construction.

The completed highway section immediately previous to lowering

The location of this work makes possible an economical method of handling of the concrete. The mixing plant is the same floating equipment which has been used for the pier construction, and gravel and sand is brought in by scow direct from the quarries of the supply company. The material is handled by clamshell from the scow into a hopper over the mixer, and a second derrick with a bottom dump bucket lifts the mixed concrete from the mixer to a small hopper at the head of an inclined track. This hopper discharges into small dump cars, which run by gravity down the incline, which is not so steep as to prevent their being easily returned by hand, the haul being only between two and three hundred feet.

The fabrication and erection of the remaining steel bascule unit has been awarded to the Canadian Bridge Company, and erection will follow immediately on the completion of the substructure, which it is expected will be in about six months time. The entire scheme should be completed well within twelve months.

Toronto Firm Secures Canadian Agency for Carrara Marbles

The Commercial Trading Corporation, Ltd., 9 Wellington St. E., Toronto, recently secured the Canadian agency for the internationally known line of Carrara white and colored marble, from the quarries owned by the famous art firm of Paolo Triscornia, of Carrara, Italy, who own and operate twenty marble quarries in that country and have executed some of the world's most famous works of art in marble, including the National monument of Queen Victoria in London, England, monument of King Edward VII at Liverpool, Eng., and others throughout the European continent and other foreign countries. "An erroneous impression held by many in Canada, in regard to Carrara marble, is that it will not withstand the vigorous Canadian winters without cracking," states our informant, Mr. Molini, sales manager of the Commercial Trading Corporation, Ltd. He points out that several monuments, statues, etc., constructed of this marble have been erected in Russia for centuries and have withstood the extremes of winter weather without a sign of deterioration. A particular instance of the weather resisting qualities of these marbles is the Troyan Tower, at Rome, Italy, which has been standing 983 years and is still in its original state of preservation. Mr. Molini also states that Carrara marbles compare favorably in price with ordinary granite. The Canadian company also handle marble terrazzo and mosaic products.

An Unchokeable Pump

The choking of pumps operating on semi-solids, is an unpleasant experience with which most engineers are familiar; and the consequent cost of removing the obstruction, the burning out of motors in electrically driven pumps, or the slipping and burning of belts in belt-operated installations are serious items which pump manufacturers have long been requested to eliminate.

The Unchokeable Pump, Limited, London, Eng., have made these problems their special study and as a result of experience have evolved a type of pump to deal with every possible contingency ensuring that whatever is capable of passing through the suction must of necessity be swallowed and discharged, and in a manner far better and far more economically than could possibly be the case from employing hand labor.

The unchokeable pump is constructed on the centrifugal principle but so designed that fibrous solids, skins, sacking, etc., will pass through it without difficulty. It is specially constructed to withstand the hard grinding work inseparable from the constant pumping of all kinds of sludge, fibres, semi-solid and solid matter. In principle the pump operates upon ordinary centrifugal lines but in internal detail the pump differs from any other. No screens are necessary for large objects that pass through the suction will be ejected at the delivery. It is particularly designed to pass unscreened sewage, a most difficult material, rags, cotton waste and all kinds of pulp and trade effluent from textile work in general. It has been found impossible to make the pump choke with solids, or semi-solids no matter how quickly or in what quantity they may be drawn into the pump.

Unchokeable pumps are also manufactured for a belt drive; vertical pumps are also supplied. Parts are interchangeable and the impeller can be easily taken out and replaced. The bearings are ring oiled. The pumps are capable of dealing with anything from the pumping of coal, gravel, rock, ore, sand, etc., down to leaves, sewage or chemical composition of fluids whether containing acids or alkalis.

As a typical instance the Unchokeable Pump, Limited, is supplying 6 inch vertical pumps with special impellers for sand and small stones for the Mersey Docks and Harbor Board. These are to be used for throwing up excavated matter containing small stones to a distance of 120 ft. These pumps, if only to throw to a height of 60 feet could have handled stones up to 5 inches in diameter.

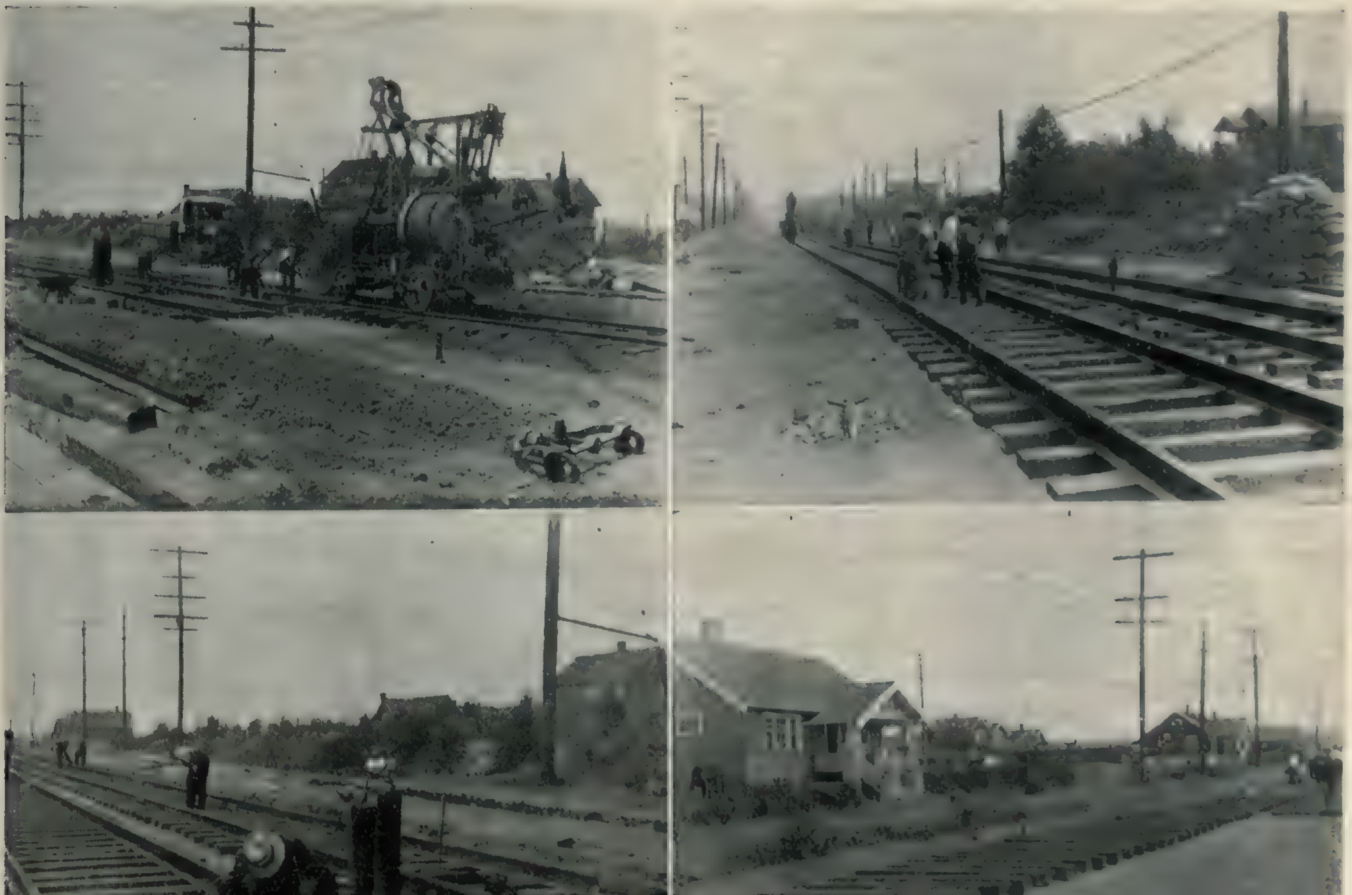
We are indebted to Jones & Glassco Reg'd., Canadian agents for the pump, for this information.

Trackage Extensions on B. C. Electric Railway Company's Lines

For the first time in a number of years, actual trackage extensions are under way on the system of the British Columbia Electric Railway Comapny at Vancouver. About a mile of track is under construction on the Broadway West line and will give a more adequate service to an already well built up and growing district.

The type of construction adopted is first class, with the heavy 8 in. rails that go with permanent pavements. Fir ties are in use, resting on about 9 inches of ballast, commencing with 3 inch stone, and finishing with about three inches of screenings. The same fine material is being used for tamping, after which a course of concrete is to be run in.

One item in which the most modern practice makes for economy is the method of bonding being used. Solid copper wire is used instead of the cable formerly in use, and connection to the rails is by welding, the oxy-acetylene process being used.



Upper left—Concrete mixing plant, dump bucket with radial arm; Upper right—Tamping track with crushed chips; concreting plant in rear; Lower left—Bonding rails by welding; Lower right—6 x 8 fir ties laid on subgrade of crushed stone chips.

Sewage Treatment by Activated Sludge Plants at Houston, Texas

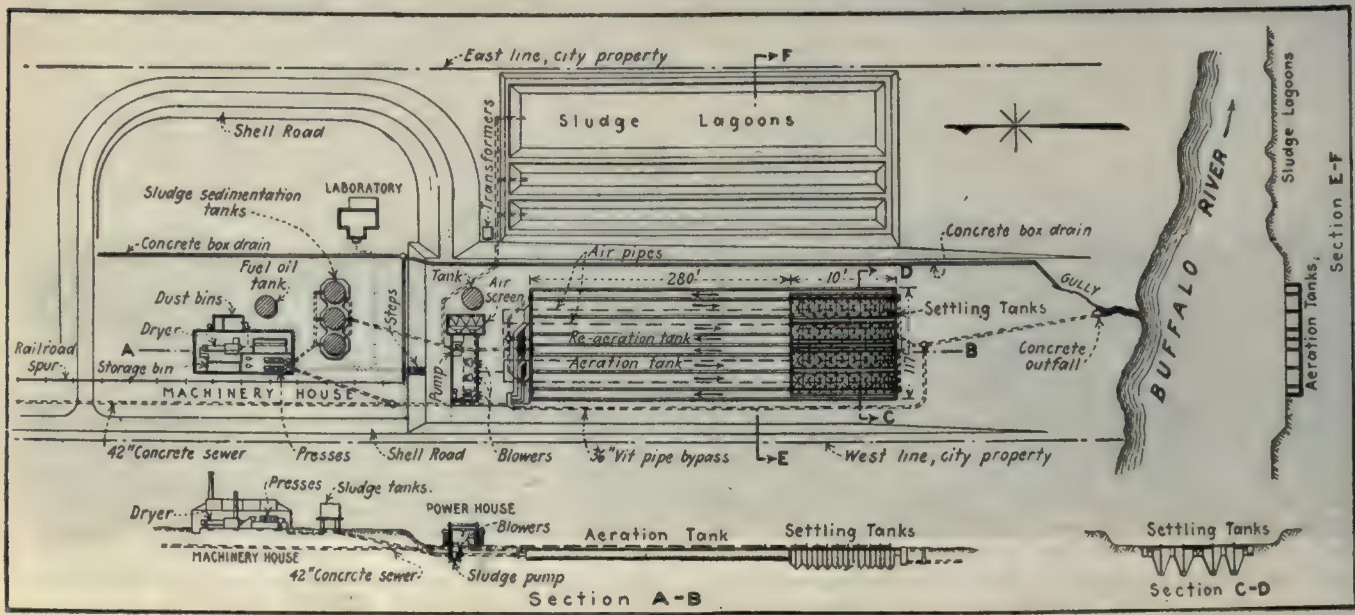
General Review of Operations at the World's Largest Unit of this Type—Operating Curves and Costs for 1920 and 1921—The Solution of the Dewatering Problem in Sight

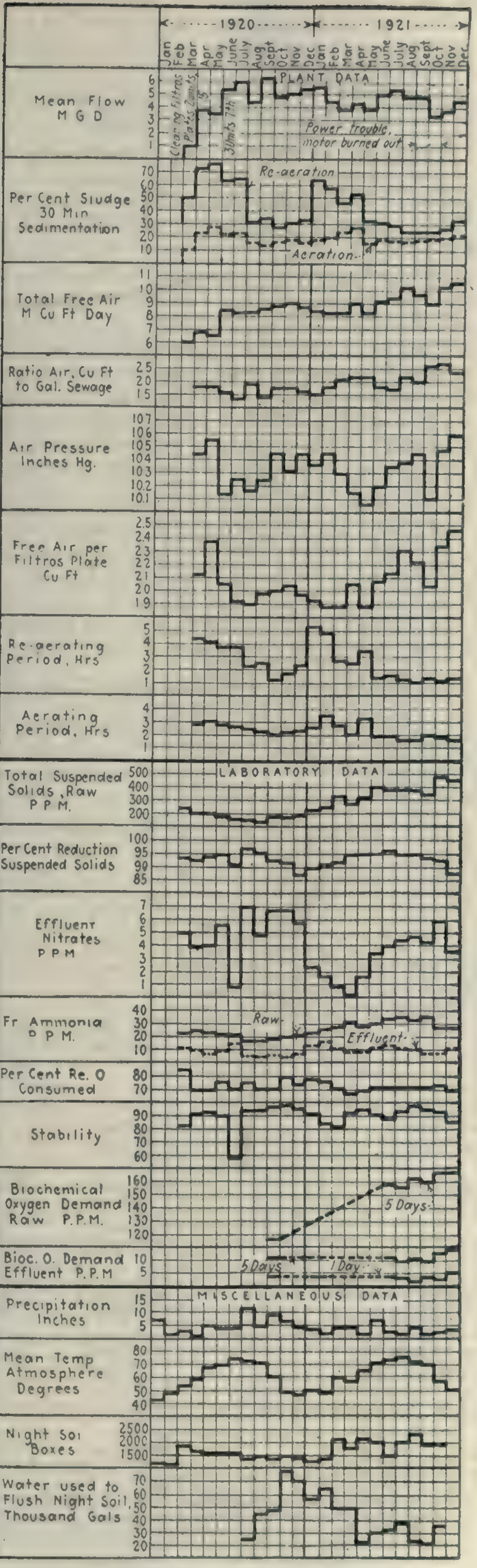
What is still the largest activated-sludge plant in the world was put in use by the city of Houston, Tex., in May, 1917, and we are reprinting herewith an interesting article on its operation from "Engineering News Record." It has a capacity of 10 m.g.d. On Aug. 10, 1918, a unit of half the size to serve the remainder of the city began service. Both plants have been operated successfully since, with sludge disposal by lagooning. In October, 1917, small-scale experiments on treating the sludge with soda ash and sulphuric acid were begun, but the results were not sufficiently promising to warrant the adoption of the process. In January, 1918, a contract was let for a dewatering plant to treat all the sludge from the north-side or larger plant by (1) further sedimentation, (2) pressing and (3) drying, so it could be sold after pulverizing as a fertilizer base. Various obstacles delayed completing this plant and putting it into operation until January, 1921, and during 1921 so many difficulties were met that the dewatering plant, although run on a working-scale basis, was not operated at full capacity. Besides testing the presses, conveyors and dryer on a working scale, the 1917 experiments on sludge conditioning were resumed in 1921, using sulphuric acid in one set of tests and sulphur dioxide and steam in another. Final conclusions on sludge conditioning not having been reached at the close of 1921 it was decided to extend the experiments into 1922. (See supplementary note at the end of this article stating that on July 8 it was believed that the dewatering problem had been solved and that the dewatering plant, with the use of sulphuric dioxide gas, and without steam, and with a continuous roller press would go into continuous full-time operation). Through the courtesy of J. C. McVea, city engineer of Houston, and G. L. Fugate, principal assistant engineer, we are enabled to present herewith many data from descriptions of the Houston activated-sludge plants, a general review of their operation to the close of the year named and more detailed facts and figures for the years 1920 and 1921 prepared by Mr. Fugate for Mr. McVea's 1921 annual report.

Houston had a population of 78,000 in 1910 and 138,276 in 1920. In the latter year, 14,420 premises had connections with sewers and there were about 15,000 "box closets," cesspools and small septic tanks. It was estimated that 100,000 of the population had sewer connections. Night soil collections are dumped into the sewers. In general, the sewers are on the separate plan, with storm-water overflows because of the illegal roof connections and manhole perforations.

Pumping and Preliminary Treatment

The sewage treated at each plant has first been pumped and then passed through outfall sewers. Before pumping the sewage flows through bar screens spaced 1 in. in the clear, while in addition that going to the north-side or larger plant passes through a grit chamber at a velocity of 23 ft. a minute. The screenings in 1921 averaged 3¼ cu. ft. per million gallons of sewage at the main pumping plant delivering sewage to the north-side or larger works and 2.9 cu. ft. from the sewage going to the other works. Some of the screenings are burned in a garbage incinerator and some are used for filling and then covered with ashes from the incinerator. There is





OPERATING RESULTS BY MONTHS IN 1920 AND 1921 AT HOUSTON 10-M.G.D ACTIVATED-SLUDGE PLANT

no record of the material removed from the grit chamber.

The Two Works

Each of the four 25-m.g.d. units of the north-side plant consist of one aerating channel, 18 x 280 ft. in plan with an area of 5,040 sq. ft.; 10 settling tanks, 10 ft. x 18 ft. 10 in. in plan, with combined top area of 1,883 sq. ft., a sloping bottom, and a depth of 22 ft.; and one re-aerating channel 9 x 280 ft., with an area of 2,520 sq. ft. In each aerating unit there are 1,050 filtros plates, the ratio of plate to surface area being 1 to 7 and the depth of sewage over the plates being 9.75 ft. The air is supplied by Sturtevant blowers, which have a volumetric efficiency of 71 per cent. under best conditions, while the overall efficiency of motors and blowers is 50.5 per cent.

Filtros Plates: Removing Iron Rust and Resetting in Concrete

The filtros plates are 12 in. sq. and 1½ in. thick, grade S, General Filtration Co. make. Originally the plates were set in cast-iron holders, secured at the north-side or larger plant with sulphur and at the other plant (built later) with cement grout. Iron rust from these holders clogged the plates so badly after a few months use that an average of only 1.3 cu. ft. per minute could be passed through each plate under an operating pressure of 11.5 in. of mercury, while some of the plates were completely clogged. The method of removing and cleaning these plates, briefly, consisted in smashing and scrapping the cast-iron holders; immersing the plates in a 10 per cent solution of hydro-chloric acid; and re-setting them with cement grout in concrete holders. About 25 per cent of the filtros plates at the larger plant were ruined since, being set in sulphur, it was necessary to break the iron to get the plates free. At the smaller plant wher cement grout was used instead of sulphur, it was possible to chip away the joints by means of an air chipping machine and only one per cent. of the plates were broken. Plates that broke into only two pieces were made usable again by sealing the break with cement grout. The plate resetting, including the new holders, cost $1,500 a unit at each plant. Three of the four units at the larger and one of the two units at the smaller plant have had the plates overhauled.

Effect of Dust on Filtros Plate

Although the concrete holders seem to have virtually stopped rust-clogging (the velocity of the air through the pipes is so low that it carries to the plates very little of the rust which forms in the pipes) there is still apprehension as to the filtros plates becoming clogged. In fact, local clogging takes place and causes trouble, as the following extract from the report shows:

The cleaned plates have now been in use almost two years and show much more clogging than is evident from the pressure diagram shown on the operating chart. This can especially be noted in the more uneven distribution of air over the tanks and the length of time required to obtain normal pressure after power has been off. Considerable power trouble has been experienced in the past six months; during the month of September (1921) the power was off nine times. Check valves are not provided in discharge lines, consequently when power is cut the blowers are reversed by the uneven pressure, thus creating a partial vacuum in the air lines. This causes sludge to settle in a compact mass over the plates and creates more top clogging than ordinary sedimentation would create.

It is proposed to install check valves to prevent vacuum forming, and also to design a machine to grind off about ¼ in. from the top of the plates. It is believed that this will prolong the life of the plates at least one year. When it becomes necessary to replace with new plates the air lines should be thoroughly cleaned of any rust and an air washer installed.

The location of the plant is such that a minimum amount of dust is held in the atmosphere. The air before reaching the blowers is screened through 8-oz. duck with a total area of 750 sq. ft. Tests show that this does not remove small particles of dust and is effective only for screening out large particles and insects which would otherwise be drawn into the blowers and transmitted to the air distributing system. These tests were run by inserting canton flannel discs in the 2-in. supply pipes. The discs would become so badly clogged with fine matter in about two weeks that the air supply would be practically cut off. The dust collected was high in carbon.

One plate was placed in an individual holder and used for nine months in one of the aeration tanks. This was removed, carefully dried, and broken. A dark discoloration was evident for about one-fourth the distance through the plate from the bottom side, similar to clogging material caught on the flannel discs. About ¼ in. on the top showed considerable clogging from sludge. The coarse matter collected in the holder under the plate weighed 4¼ grams, 21 per cent of which was volatile.

The general operating results in 1920 and 1921 for the north-side or larger plant are shown by the accompanying diagram. The smaller plant, Mr. Fugate states, has given good results, with not a single sample of effluent showing less than 99 per cent relative stability, and with the effluent containing more dissolved oxygen than is necessary to satisfy the five-day bio-chemical demand. The volume of sewage treated is way below the full capacity of the plant.

Relative Value of Chemical Analyses

Under this head the report says:

The composition of the raw sewage with an increment of increase in strength is fairly constant and tests need be run only occasionally as a check, except that the tests for nitrogen as free ammonia, bio-chemical oxygen demand and suspended solids should be run each day.

The test for free ammonia is one of the most important tests for controlling the operation of the plant. The free ammonia of the effluent varies widely, depending upon the sludge condition. If the sludge is in the best condition there will be only 2 to 5 p.p.m. and it is desirable to keep the value below 10 p.p.m. There are also rather sharp changes in the amount of free ammonia which are without explanation, and very often if the operation is continued in exactly the same manner, the ammonia will come back to a low value.

The test for nitrates is a fairly good indication of the condition of the effluent. In the best working conditions the nitrate value is very low. The test is easy to make and may be taken each day with very little trouble.

The nitrate test is, if anything, more important than the free ammonia test. It has been noticed that in the very best condition of the sludge the value of the nitrate should be about 40 per cent. of the value of the free ammonia in the raw. It is desirable to keep the value above 2 p.p.m. The effluent usually has good stability if the value of the nitrates is above 2 and the value of free ammonia below 10.

The oxygen consumed test is not considered of any value in the operation of the plant and will be discontinued this year. The test for suspended solids is of more value as a matter of record and in making certain computations.

As a final analysis the relative stability records both by the methylene blue tests and the bio-chemical oxygen demand tests are certainly necessary and give a good indication for the final object in the operation of the plant, but are of little value in control operation as the time required is too great for immediate results. The sludge changes very quickly and the tests for free ammonia and nitrates give the results at once and if necessary a change in operation can be made.

The increase in the strength of the sewage during the past two years, as measured by suspended solids, free ammonia and by bio-chemical oxygen demand, and by the screenings, is attributed by Mr. Fugate to an increase in night soil collection and a decrease in both per capita water consumed and ground water infiltration, the latter because of the dry year.

Construction and Operating Costs

The cost of each activated-sludge plant not including land or the $82,787 paid for the north-side dewatering equipment, together with a summary of 1921 operating costs, is shown by Table I.

Table I. Construction and 1921 Operating Costs for Houston Activated Sludge Plants

Construction Cost*	North Side	South Side
Excavation	$ 25.822	$ 6,361
General contract	194,405	87,789
Crane	1,125	1,125
Motor and blowers	7,245	6,199
150-h.p. Diesel engine	7,646	......
Sludge pump and motors	526	525
Wayne oil tank	86	43
Concrete fuel oil tank	1,200	......
Well	......	1,350
Elevated steel tank	......	1,917
Water pump and motor	......	373
Filtros plates	6,439	3,219
Miscellaneous	82	18
Total	$244,576	$108,919
Engineering and incidentals	10,095*	7,656*
Grand total	$254,671	$116,575
Cost per m.g.d. cap.:		
Without engineering, etc.	$ 24,475	$ 21,784
With engineering, etc.	25,467*	23,315*
Operating cost in 1921:		
Monthly salaries	$ 6,938	$ 5,297
Weekly salaries	4,223	2,172
Power	11,134	2,535
Supplies and maintenance	3,813	366
Total	$ 26,108	$ 10,370
Cost per m.g. treated	$ 16.30	$ 15.20

*From the article in Engineering News-Record, Dec. 11-18, 1919, p. 1003, based on notes obtained at Houston, the preceding November by a member of the editorial staff of that Journal, it appears that the construction cost figures include no allowance for 50 acres of land bought by the city at the north-side and 15 at the south-side works, of which only some three acres is used for works purposes in each case. The items for engineering and incidentals have been taken from the article named above, as they are not included in the report on which this article is based.

Sludge Lagooning

At both plants the sludge has been satisfactorily lagooned, without creating any nuisance, Mr. Fugate states. Deep lagoons have been used at both plants, but at the south-side of smaller plant it is proposed to construct and try three shallow ones, about 2 ft. deep and an acre in area in the hope that the material will dry "sufficiently to be hauled away by farmers." As to the quantity of sludge produced, Mr. Fugate states that measurements have not been possible, (it is hoped that they may be in the future). He submits the following estimate:

By taking the number of hours the sludge pump was run in November and December, 1921, using an estimated capacity for the pump and the average moisture in the sludge, and checking against the quantity of suspended solids in the raw sewage, the result for November would indicate a digestion of 54.8 per cent. and for December, 48.6 per cent. Using the average solids in suspension for the year 1921, a quantity of 1,518 lb. of 10 per cent. moisture sludge per million gallons sewage is derived. However, it is believed that the figures should be used with caution as possibly the pump rating may have been in error due to changing conditions between the observations from which the average capacity was estimated.

The amount of digestion in the lagoons, Mr. Fugate thinks, is indicated by the difference in the volatile matter of the fresh and the lagooned sludge, as shown by Table II. The character of the lagoon effluent may be judged from Table III.

Table 11. Analysis of Fresh Activated Sludge and of Sludge from Lagoon Edge, Nov. 26, to Dec 4, 1917

	Fresh Activated Per Cent	From Lagoon Edge Per Cent
Volatile	70.12	55.42
Fixed	29.89	44.58
Fats (ether soluble, dry basis)	9.28	9.51
Ammonia (dry basis)	5.58	3.95
Phosphonic acid (total, P_2O_5)	1.45	1.29

Table III. Analysis of Sludge Lagoon Effluent, Dec. 13, 1917

	P. P. M.
Free ammonia—nitrogen	92.00
Nitrites —nitrogen	00.05
Nitrates —nitrogen	00.40
Organic —nitrogen	12.00
Suspended solids, volatile	50.00
Suspended solids, fixed	16.00

(Continued in next week's issue.)

The Stephen Construction Company has received the contract for the paving of Haymarket Square and Rothesay Ave., St. John N. B. and work has been started on this contract. This company, headed by J. H. Doody of St. John. had the contract for paving Douglas Avenue in St. John last summer and fall. The company has also taken over the brick manufacturing business at Little River, N.B., conducted for one hundred years by Lee and Sons.

P. Mooney & Sons St. John N. B. are finishing up on their contract for the St. Peter's Ball Park in St. John. A large amount of rock has been removed from the ground and a grand stand has been built and bleachers at third base and left field. A few years ago this property was a sloping mass of rocky ground. Now it is the leading ball park of the maritime provinces.

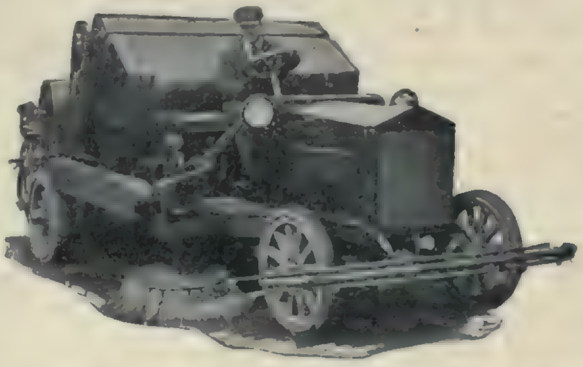
A Concession to Home Investors

In offering to renew the five and a-half per cent. Canadian Government bonds, maturing December 1st, at the same rate of interest as is carried by the maturing bonds, and allowing a bonus of one month's interest, the Minister of Finance is making a material concession to the Canadian investor, as this rate is higher than was paid on the recent Canadian loan in New York. The high class of the security, which is the very best that can be offered in Canada, and the liberal rate of interest should lead to large investment in these Dominion bonds. Attention is directed to the official advertisement giving details.

The Austin Western Motor Sweeper

The Canadian Fairbanks-Morse Co., a few days ago gave a demonstration of their Austin-Western Motor Sweeper before the officials of the Street Cleaning Department of the city of Toronto. In this connection it is interesting to note the favorable report on this machine made by the city engineer of Niagara Falls, N. Y. where one of them has been in operation for some two years. The following extracts are from the report:

In its two years' operation our Austin-Western motor sweeper has saved its cost three times over the hand method, besides being much more sanitary and efficient. It has saved us $.4210 per sq. yd. swept, or $3.95 per cu. yd. of refuse removed, making the total net saving for the two years over $20,000.00. It replaces 16 hand sweepers, and costs only half as much as an inefficient horse drawn brush.



The City of Niagara Falls contains about 60 miles of pavement that must be kept clean. About 4½ miles in the business district are cleaned every night. The remainder of the 60 miles, which are in the residence districts, are cleaned less often, averaging about once a week for the better class sections. Two years ago we bought an Austin-Western motor sweeper to replace the men and horse sweepers.

The total operating cost for the 2 years was $11,508.26, or $31.62 per day worked. The cost per 1,000 sq. yds. is $.2245, and per cu. yd. is $2.11. The average number of square yards swept per day is 140,800. and the number of cu. yds. of dirt removed per 1,000 sq. yds. of pavement is .1065. We consider these costs unusually low.

The total cost of the hand method for the 2 years, including hauling the dirt, would be $40,586.00, as against $19,006.66 for the Austin-Western motor sweeper and 2 teams for hauling dirt. The net saving is $21,579.34 for the 2 years, or an average annual saving of $10,789.67, which returns 142% on the investment.

Iron and Steel and Their Application in the Cement Industry

Obtaining Steel to Suit the Purpose—Reasons for Failure of Steel Under Certain Conditions—Co-operation of Cement Engineer and Steel Plant Metallurgist Advocated

By **W. R. SHIMER, Sales Metallurgist**
Before the Portland Cement Association

It was my original intention to present a paper containing definite recommendations for the more important iron and steel parts used in machinery for the manufacture of cement. Upon going into this phase of the subject in detail, I find that, due to various local conditions, a steel which is satisfactory for a certain part at Cement Plant "A," may not be suitable for the same part at Cement Plant "B." This is due to various reasons such as difference in hardness of rock, type of machinery, condition of machinery, personnel of men operating the machinery, etc. I will, therefore, confine myself to more or less general remarks and attempt to show how to obtain steel which will best suit the purpose, and how to draw up specifications which will assure a satisfactory product.

The writer cannot claim to be familiar with the mechanical details of cement machinery, and is, therefore, not in a position to ascribe failures to faulty design, although from an examination of certain failed parts there is every indication that some of the failures can be atributed to error in design. For example, the writer had the opportunity to investigate the breakage of shafts in an electrically operated shovel. This shovel was operated in the same quarry with two steam shovels. No shafts were known to break in either of the steam shovels, while the shaft greakages in the electric shovel were quite frequent. The writer was called in on this matter after the cement plant had proven to the engineer who built the shovel that power was developed which stressed the shaft to a load of twice that for which it was originally designed. In other words, when the electric shovel was attempting to dig out the side of a hill in one scoop, and since an electric motor will withstand a 100 per cent overload momentarily, the shafts were stressed to double the amount for which they were designed, and as this stress was a sudden one, the shafts naturally twisted off. I understand that when a steam shovel is overstressed, it will stall; there are no sudden shocks, and consequently shaft failures are much less frequent in shovels of this type.

Special Steel for Electric Shovel Shafts

The shafts in the electric shovel could not be made larger without making very radical changes throughout the entire mechanism, and it was, therefore, necessary to use a special nickel chrome steel, heat treated to give more than twice the elastic limit of the original shafts, and at the same time, the elongation and the contraction of area had to be fairly high to insure sufficient ductility to withstand the usual shock and vibration.

The physical properties of the failed shafts showed.

Tensile Strength	62 000
Elastic Limit	32,000
Elongation, per cent	35.5
Contr. of Area, per cent	61.07
[illegible] Strength	112,000

The heat treated alloy steel shafts showed:

Elastic Limit	90,000
Elongation, per cent	22.5
Contr. of Area, per cent	64.0

These physical properties more than make up for the deficiency in the size of the shaft.

It might be of interest to mention in this connection that for quick repairs cold drawn shafting was used for shafts in this shovel, and some broke in one week's time.

While on the subject of cold drawn steel, I might mention its properties and the object in using it. It is made by pickling all the scale from the hot rolled bar, which is then pulled through a die 1/32 to 1/16 inch less in diameter than the original bar. This produces a bar of accurate size, with a smooth, bright finish. The bar is reduced cold and while cold extends in length in proportion to the amount of reduction in cross section. Low carbon steel is cold drawn without annealing but the higher carbon and alloy steels are annealed first. The physical effect of this cold working is to raise the elastic limit, in the smaller diameters, up to approximately 90 per cent of the ultimate tensile strength, with a corresponding decrease in ductility. Prior to cold drawing, the elastic limit of the same steel approximates 50 per cent of the tensile strength, with considerable ductility. I would not recommend that cold drawn steel be used for important structural parts which must withstand shock and vibration. It is an excellent steel for screw stock, bushings, sockets and parts of this nature which must be turned out cheaply by the thousands on automatics. It is satisfactory for line shafts and other parts of like nature which are not highly stressed. Some years ago an automobile company in an attempt to save money on lathe work, used for a time, a cold drawn alloy steel for axles. They were drawn to finished size, and all the machining that was required was to cut to length and mill the ends square. This proved to be expensive economy as these axles failed in many of the cars after short service, and replacements were made free of charge in order to satisfy the car owners. The replacing axles were made of a special heat treated alloy steel, and they returned to the practice of turning the bars on a lathe rather than obtaining the accurate size by cold drawing.

Cold drawn steel has its field, and I do not wish to be misunderstood in my remarks concerning it. It is, however, false economy to use it for highly stressed parts, as there are so many steels which can be heat treated to stand up under severe service and which will far outlive cold drawn steel.

Heat Treatment

Many parts fail in cement machinery on account of not being heat treated, or having been improperly heat treated for the service to be performed. Many times steel of correct composition for a certain use fails in a very short time, because of improper heat treatment. When properly heat treated this same steel will give satisfactory service. As a concrete example of this, I will cite the case of an order we received some years ago for ten bars of nickel steel four inches in diameter. This order was received from a drop forge concern and from the composition of the steel ordered, it was inferred that the steel was to be cut up and forged into gear blanks, which were to be subsequently heat treated. This steel was, therefore, shipped to the customer in its annealed condition, having been annealed for machinability. A short time later, we received a complaint, stating they had made piston rods from three of these bars and put them in drop forge hammers. One lasted 2½ hours and broke; another lasted 5½ hours, and the third lasted about 15 hours. They stated this so-called high grade nickel steel was inferior to brass wrought iron. The remaining seven bars were returned and given a special heat treatment by quenching in oil, with subsequent annealing, and were returned to customer and were found to be entirely satisfactory. This is one of many examples which could be cited to show that while steel properly heat treated is satisfactory for the service required, steel of the same heat but improperly heat treated is not satisfactory. I might mention that in order to obtain the best service from alloy steels, they must be heat treated, as it is not good economy to use them otherwise. When heat treated, they are far superior to ordinary steels.

Proper attention is not always given to steel castings, due in part perhaps to the users feeling that because the casting was made of steel instead of iron that it had all the strength that was required, with the result that no check was made as to the analysis of the steel, or to its annealing. This applies, of course, to commercial castings. There has come to my attention quite a few failures of machines where steel castings have been used. The machines in mind at the present time are large jaw crushers.

Up to a few years ago, the primary crusher was fitted with a jaw opening of about 24 by 36 inches but with the advent of steam shovels, it became necessary to increase the size of crushers with the result that these machines are now built with openings up to 5½ by 7 feet. In the designing of these larger size crushers, the manufacturers went to the use of steel and made a great many of the crushers in sectional design, i.e., the side frames and end frames being separate castings, machined and held together by turned bolts. Another design of crusher consists of a "semi-steel" frame reinforced with a cast steel band around the top. The design of this crusher is such that the steel bands take all the crushing strain.

Failures of Steel Crushers

The failures of these steel crushers have been due partly to the fact that the analysis of the steel was incorrect, and partly to the fact that the castings had not been properly annealed, if annealed at all. In one of the large plants, not so long ago, there was broken in operation a crusher in which the frame was 20 feet long and the cross section of the steel about 6 inches by 5½ feet. The breakage of these castings showed that the steel was very coarse grained and that it had not been properly annealed, with the result that original strains were still in the castings. Had these castings been properly annealed, there is no question but that the machine would have stood up and that the breakage would not have occurred. The repairs to this particular machine will cost the operating company many thousands of dollars, as the machine will first have to be banded together to permit it to continue to operate, and later the side frames entirely replaced with new castings.

There has also been brought to my attention the failure of a crusher which was reinforced with a heavy steel band. This band was of oval shape and had a wall cross section of 5 by 24 inches. It broke at three points almost simultaneously, and the nature of the breaks indicated brittleness. Upon investigation, it was found that the casting was too high in carbon and further that it had not been properly annealed. The microscope showed a structure of steel in the same condition as when cast, and if it had been annealed at all, it only went through the motions of this operation, as there was no indication whatever of annealing from the examination of the casting itself.

Foundries or forge plants will often, in order to fill up their shop, take on work for which they are neither trained nor equipped to handle. Sometimes, by good fortune, their product stands up in service, but in many cases like the one just cited, it did not, and caused considerable loss to the cement plant and considerable embarrassment to the crusher manufacturer, who was not directly to blame. Manufacturers of machinery should, however, investigate the foundry prior to placing orders for castings, to determine if they are competent to make such castings, and the castings should be inspected to be sure they are of the right composition and properly annealed.

The practice generally followed is to specify certain physical properties in accordance with the specifications of the American Society for Testing Materials. These tests being taken from coupons which are attached to the casting, and heat treated with the casting. Test coupons are integral with the casting. They should not be broken from the casting until it has been heat treated. If by accident, the coupons should be broken off prior to annealing, they should not be heat treated separately but should be charged in the same annealing furnace at the same time with the casting in order that it receive identical heat treatment with same. This is necessary in order to be assured that the physical results obtained from the coupons represent the physical properties of the casting itself.

No Reflection of the Machine Manufacturer

Failures such as those just briefly cited might mislead prospective purchasers into believing the machinery itself was at fault. In cases of this kind, no reflection can be cast upon the make or design, because the failures are directly due to the fact that the makers of the castings did not furnish a good product. it is always unwise to place an order for a special part to the lowest or any bidder, without first having been satisfied as to his ability to furnish a satisfactory product.

I believe I am safe in stating that the average mechanical engineer knows steel only in a general way, as he has neither the time nor the opportunity to keep up-to-date with the rapid advances made in this art. Even we, who are working on this subject all the time, find it difficult to keep pace. An engineer will design a part and figure on a certain factor of saftey, for example of 5 to 1, when he expects to encounter shocks, etc. With this factor of safety, he may require steel of say 110,000 lb. elastic limit, which predetermines an ultimate strength of approximately 140,000 lb., but loses sight of the fact that to meet this high elastic limit, the elongation and contraction will be relatively low, and he will have a steel lacking in ductility, so that the real factor of safety is actually much lower. For such a highly stressed part, he would have a more satisfactory product if he used a factor of safety of 4 to 1, and asked for a steel having, say 90,000 lb. elastic limit with proportionately lower tensile strength, since he would have a corresponding increase in ductility, thereby enabling the part to withstand shock and vibration.

Shafts for Gyratory Crushers

One big problem in some cement plants is to obtain satisfactory shafts for gyratory crushers. Low to high carbon steels and alloy steels heat treated for high tensile strength and elastic limit have been used, but certain plants still have more breakages than they should. I have been investigating this subject with a view to developing a satisfactory steel and a heat treatment for this purpose. In general, I find the tensile properties need not be high, but the important properties are elongation and contraction of area. The shafts which on the average stand up longest in service are those with greatest ductility.

I have interviewed a number of cement plant orerators who use the gyratory crushers and find such shaft failures are peculiar to certain plants, while others rarely if ever have this trouble. The plants which have no failures attribute their success to the fact that they make a special effort to keep dipper teeth, sledge hammers, and other iron and steel parts from going through the crusher. The penalty to employees allowing such parts to go through is dismissal. I am inclined to believe that this is one of the major reasons for shaft breakages as this would explain why the harder shafts are more susceptible to failure than the softer and more ductile ones. When a large piece of steel passes through a crusher, something has to give, as the crusher itself cannot stall. If the liner plates do not break, the shaft must distort. A hard shaft will act as a spring, but the excessive strain which has been put on some points usually on the outside surface, will produce a nick of perhaps microscopic size, which we might call an incipient break, and during continued service, it grows larger, finally resulting in the fatigue break, which these shafts manifest on fracture. The softer steel shafts will bend and at times even take a permanent set, but there is no doubt but that the increased ductility accounts for their being longer lived . When a plant has an unusual number of breakages of this nature, and if it is certain no foreign material has gone through the crusher, an investigation should be made by a competent party, as such a condition can generally be corrected either by a change of steel or by special heat treatment. I understand some gyratory crushers are being redesigned in order to permit shortening of these shafts, and that these shorter shafts are reducing the breakages to a considerable extent.

I can easily imagine how the cement plant engineer, or the engineer building machinery, who might interview six to a dozen representatives from as many different steel concerns, could become confused when attempting to boil down the diversified information received. The same thing would happen if the writer were in the market for cement, and with his limited knowledge of this product, would have difficulty deciding whose cement was best after interviewing representatives from as many cement companies. I would probably purchase from the lowest bidder, and no doubt obtain just what I paid for, namely, an inferior product . The enthusiastic steel salesman may elaborate on the wonderful physical properties of a special alloy steel, representing results obtained from a small test bar, and leave the cement engineer to believe that these results can be obtained in a 15 or 20-inch diameter forging. Were the engineer to attempt to purchase a forging requiring such high properties, the reliable steel manufacturer would try to discourage such requirements, but the engineer might find some one hard up for work who would try to furnish it, and the chances for its giving satisfactory service would be very slight.

Cement Machinery Receives Much Abuse

I believe I am safe in stating that cement machinery must stand as much or more abuse than machinery for most other industries, on account of the abrasive materials handled, and the considerable amount of dirt and dust always found in the cement plant, which becomes imbedded in bearings. Some parts must stand both wear and shock, and some must stand either shock alone or wear alone . In the case of parts which must stand both wear and shock, a happy combination can be obtained by means of case hardening the outside surface, which will resist wear, retaining a strong and tough core to resist shock. In the case of a part which is not subjected to shock, this can be made of a steel which can be hardened throughout. In the case of a part which must stand severe shocks and vibrations, certain steels can be specially heat treated to stand up for this service. It is my impression that certain parts, such as gludeons, liner plates for tube mills and crushers, are expected to wear out in a certain length of time, and replacing material is ordered without investigating the possibility of obtaining a material which will give double the service or better. It seems that breakages and excessive wear are accepted as a matter of course by many cement plants. There are manganese steel castings made which stand up best under certain conditions at one plant, while some other special steel casting or forging will give better service at another plant . Each plant has its own individual problems which can be worked out by the proper co-operation with reliable steel manufacturers.

Take pinions, for example. Cast iron pinions are cheapest if the first cost is considered only. Occasionally a cast iron pinion makes an exceptional record, but how often is a cast iron pinion obtained which wears out or breaks in a short time, usually breaking before being worn out, and where the cost of labor and curtailment of production on account of repairs would make the ultimate cost considerably higher than if good special, heat treated pinions had been purchased in the first place.

Satisfactory iron or steel for almost any purpose can be obtained if the manufacturer is acquainted with full details concerning requirements, and if he is paid the price. No matter what the commodity is, we generally receive the quality we pay for. When a cement company wishes a forging and is only willing to pay a certain limited price per pound it will receive a forging which is worth the price paid for it and no more, since in order to make a forging at such a figure the steel manufacturer will have to select his steel accordingly, and perhaps at this price he cannot afford to heat treat it. If a forging is required, payment of a fair price to a reliable manufacturer will secure a special steel properly selected, and will insure careful heat treatment for the service required. Though such a forging might cost three times as much per pound, it would probably last more than three times as long; but if it outlives the lower priced forging only 2½ times, it would be cheaper in the end, on account of continued operation during this extended period and saving on cost of taking down and reassembling. In the case of the steel casting failures on the jaw crushers mentioned earlier in this paper, these castings would no doubt have been cheap at 50 cents a pound if they had not broken.

Need For Intelligent Co-operation

The cement engineer should work closely with the steel plant metallurgist and the cement plant purchasing agent should work closely with the cement engineer. In cases where the purchasing agent does not co-operate with the engineer, he will buy steel other than that specified by the engineer if he can obtain a reduction in price. This reduction in price may be quite costly, due to curtailment of production and cost of repairs on account of break-downs. If there are parts which break or wear out too soon, the cement plant should look for something to give better service and go to a reliable source of supply, state what is wanted, with a complete history of the average service obtained from past material, and details of its iron or steel composition. With such information, the metallurgist should be able to recommend iron or steel which would be more satisfactory, and while many times he may recommend steel which will cost somewhat more, sometimes he finds a high priced steel being used where a much cheaper steel would have given as good or better service.

Before closing, I wish to emphasize the importance of co-operation between the cement engineer or the engineer building cement machinery, and the steel plant metallurgist. In our corporation, we find it valuable for our plant engineers and engineers who are designing or building machinery to keep in constant touch with our metallurgical departments. When they design a machine to perform a certain operation, they first consult the metallurgists to determine which steel will best stand up in service, and the physical properties which can be obtained from this steel, and they then design their machinery accordingly. In some plants the designing engineer will design his machinery independent of metallurgical advice and make some parts so light and at the same time requiring extremely high physical properties, that he works a hardship on the metallurgical and heat treating departments which must resort to the use of high priced alloy steels, which may be very sensitive to heat treatment, and which may crack and distort during the drastic heat treatments needed to obtain the extremely high physical properties . This results in high shop losses and often in the installation of defective parts, causing failure in service. Where there is close co-opeartion between the engineer and metallurgist, such a condition is not likely to occur, and although the machinery may be somewhat heavier, it will be more efficient. The metallurgist finds it necessary many times to consult with the engineer before recommending steels for certain parts in order to become acquainted with the exact details of the duty which the particular parts are to perform. We find in our corporation that neither can get along without the other, and certainly this same condition must hold true with the cement industry or any other industry using iron or steel.

Hard Facts About Concrete

Do you know that no single factor has so great an effect upon the strength of concrete as has the amount of water used?

Thousands of tests conducted at the Structural Materials Research Laboratory, Lewis Institute, Chicago, prove that a direct relation exists between the quantity of water used in mixing concrete and the strength of the resulting concrete. These tests mean money to the builder because strength is what he is after.

A variation of ten per cent. above or below the correct amount of mixing water may reduce the strength of the concrete by thirty per cent. or more. The very wet, sloppy mixtures that are sometimes used in building construction result in a loss in many instances of from fifty to sixty per cent. of the possible strength of the building.

Within the range of plastic mixtures, the strength falls off rapidly with the addition of a small amount of superfluous water; in a one-bag batch the addition of even one pint of water more than is necessary to give a workable mix results in the same loss of strength as if from two or three pounds of cement were left out of the mixture. That's money out of the pocket for the builder.

The exact amount of water required for any particular mixture of aggregates to obtain the greatest strength in the concrete can be determined only by actual test. Workability of the mixture is important and must not be sacrificed. As a basis for trial with well-graded aggregates up to 1½ inches in size, and a 1:2:4 mix use 6 to 6½ gallons of water per sack of cement. For a 1:2:3 mix begin with 5¾ to 6 gallons, and for a 1:1½:3 mix, 5½ to 6 gallons. Remember: Use the least amount of water that will give a workable mixture.—Concrete Builder.

Ottawa Firm Sells Out

Messrs. Hooper Bros., Ottawa, who have carried on a successful stone cutting business for some 25 years, have sold out their plant and a number of unfinished contracts to the Ottawa Cut Stone Company. Mr. Blackwell is manager of the latter company and is now moving his old business from Nelson Street to the old Hooper Bros.' premises, corner of Elgin and Isabella Streets. Mr. Blackwell says business is good; he has just received a contract for the cut stone for the Nepean High School to be built at Westboro, Ont.; also for cut stone for the new hydro sub-station, corner of Carling and Bronson Avenues, Ottawa; also for soldiers' memorial at Almonte, Ont.

Paris Inaugurates Big Street Program

The municipal authorities of Paris, France, have begun carrying out a vast program of street improvements authorized some time ago. The sum of 11,500,000 francs is being spent for the transformation of stone paving into asphalt paving with more money to be expended later. Among the streets to be improved are the Grand Boulevards, Rue de Rivoli, Rue Montmartre, Rue de LaFayette, Avenue du Bois de Boulogne, Place de la Concorde, Boulevard Malesherbes, Avenue des Champs Elysees, Place Vendome, Place de L' Etoile and a score of others more or less familiar to thousands of tourists.

Tunnelling Under Difficulties

Special Construction Methods to Combat Unstable Condition of Ground in Sewer Work

By W. G. CAMERON, B.A.Sc.
Assistant Engineer, Sewer Section Works Dept. Toronto

In the article on "Difficulties in Sewer Tunnelling in Wet, Unstable Ground," in the Contract Record of July 5, 1922, page 660, reference was made to the tunnel lining having been commenced at the invert, and although this is no doubt a correct and customary place to begin building still, circumstances alter cases. Whether in tunnel or open cut, we frequently have soft spots in the ground that can easily be bridged over temporarily and the sewer portion built later when conditions will permit. In such cases, if the lining is concrete, it does not require any support, but if brick, it is as well to span the place with some sort of a girder.

This condition often occurs in compressed air tunnels, and it is caused where pockets of wet sand exist, reaching below the invert. As the pressure is usually not sufficient to thoroughly dry these, the space is temporarily bridged over in the above mentioned manner. Of course it is not advisable to do this where the ground is all running sand, but only where pockets exist or where the ground lies in vertical strata.

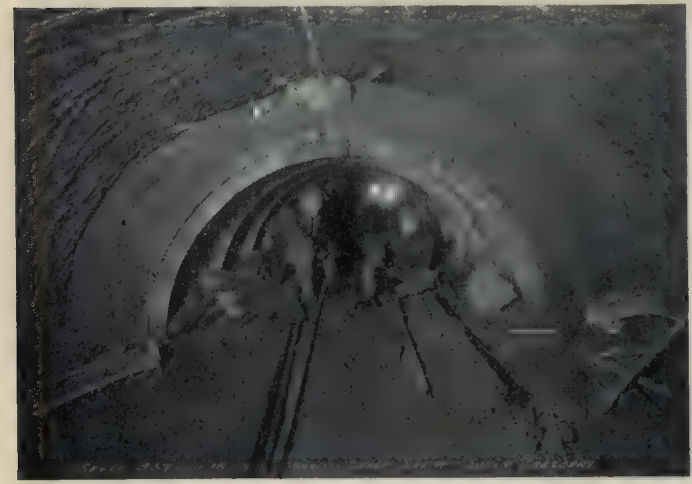


Fig. 1—Upper half of lining built first

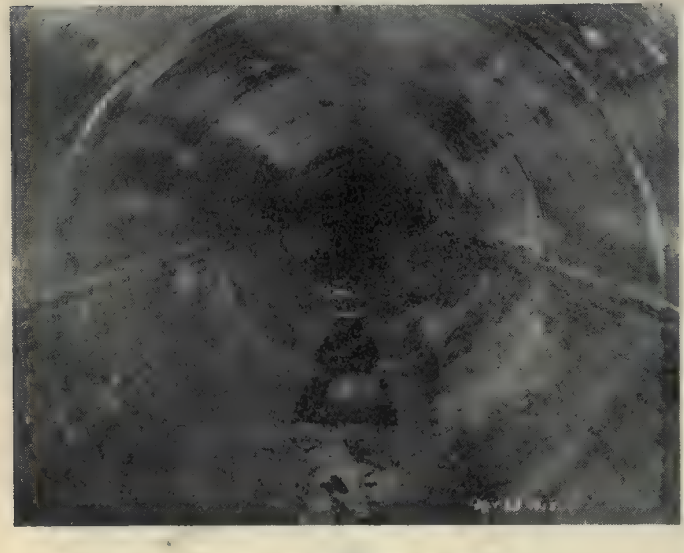


Fig. 2—Wearing surface in bottom

Method of Construction

In the case in point, the ground was mostly hard clay, but it had wet sand pockets and horizontal strata. The ground was dry and all clay to a point below the springing line. The lining was composed of concrete. It was accordingly decided to build the upper half first, Fig. 1. The excavation was made in two benches, the upper to a point a few inches below the springing line of the future lining. Planks were then laid in trenches prepared for them below the position of the future walls, the forms set and the concrete poured. Later, when this upper portion was thoroughly set, the lower portion was taken out in sections varying in length from 8 to 16 ft., according to the condition of the ground. The arch in the meantime was allowed to bridge the gap. The lower portion of the lining was poured in such a manner as to leave a space between the upper and lower portions, which was later filled with a brick key, Figs. 3 and 4. The lining was 1:3:5 concrete, 18 in. thick and 8 ft. in diameter. A ring of brick was placed in the lower half as a wearing surface, see Fig. 2.

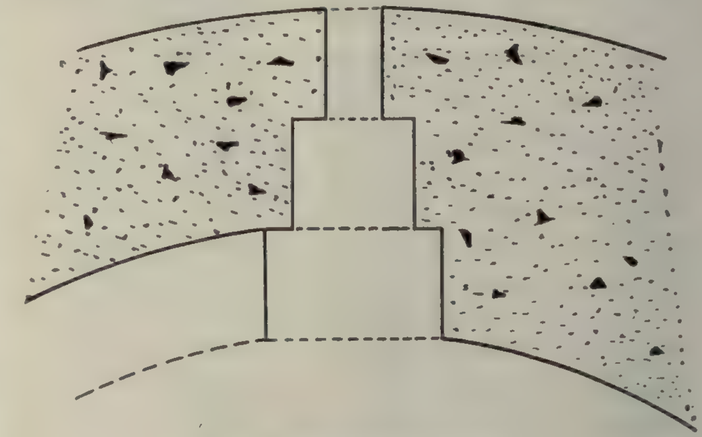


Fig. 3—Space left for brick key

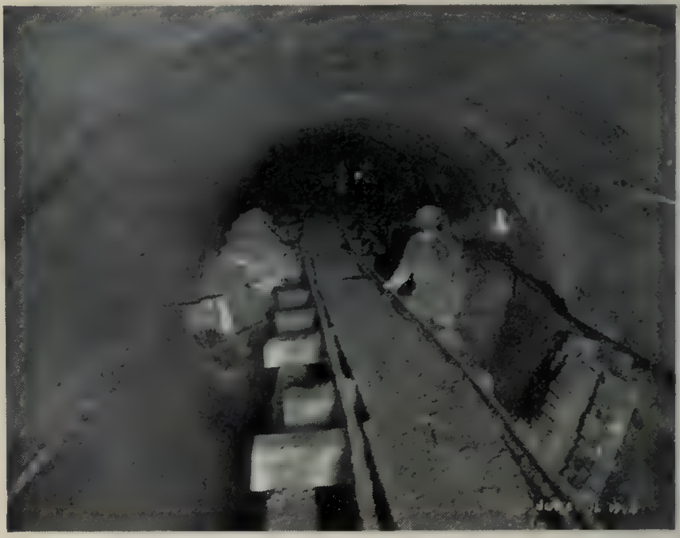


Fig. 4—Showing key and manner in which it was placed

Fire Test Report on Gunite Walls

The question of the fire resisting qualities of concrete is occasioning considerable discussion at the present time due especially to a report made by the British Fire Prevention Committee on the fire resisting quality of aggregates. It, therefore, is of interest to make a brief resume of the methods employed and the results obtained by the Underwriters' Laboratories on tests made on walls built of Gunite as described in a report dated May 12th, 1922, and just issued.

In this work the regulations of the Underwriters as well as of the Fire Prevention Committee of the American Concrete Institute provide that two samples must be tested, one to be subjected to the standard temperature curve, which calls for a heat of 1,000 degrees F. in 5 min.; 1,300 degrees F. in 10 min.; 1,550 degrees F. in 30 min.; 1,700 degrees in one hour; 1,850 degrees F. in hours, and 2,300 degrees F. in eight hours, sample to remain subjected to the heat until such time as the temperature on the side away from the flames shall reach 300 degrees F. at any point. Another sample shall be similarly prepared and subjected to the standard heat for a period of one hour at which time it shall be immediately removed from the furnace and subjected to a stream of cold water applied at from 60 lbs. to 80 lbs. pressure from a fire hose for a period of from 3 to 8 minutes.

The first of these tests is known as the fire endurance test, and the second as the fire and hose stream test, and the acceptance and rating of any wall is based on its ability to withstand:

1st. The passage of flames.
2nd. Resistance to decalcination or dehydration.
3rd. Capability of restoration after a fire.
4th. The period of resistance of the passage of heat.
5th. Resistance to destruction from impact or similar causes.

In regard to the fourth provision there is a regulation of the various bodies to the effect that a time rating is given of 80 per cent. of the period elapsing before the temperature of 300 degrees F. is reached on the unexposed side, as it is generally recognized that when this temperature is reached there is danger of spontaneous combustion of materials away from the exposure and adjacent to the wall.

The Equipment

The standard equipment of the Laboratories as described in the Appendix of this report is of an interesting character. The furnace proper consists of a hollow combustion chamber approximately 12 ft. wide, 14¾ ft. high and 16 in. deep. communicating at the bottom with a pit about three feet in depth. The combustion chamber is enclosed by a solid brick wall at the back and one end, and by movable brick walls in steel frames at the front and other end. The removable walls are suspended from overhead steel beams by trolleys, the wall forming the front of the furnace being the movable walls previously described. The top of the furnace consists of heavy fire clay blocks containing six vents leading to a stack. The vents are provided with a damper made of fire resisting material. Each end wall of the furnace is provided with four observation holes glazed with mica and so arranged that all parts of the test panel may be observed. Observation galleries outside of the furnace afford access to the upper observation holes.

The furnace is heated by means of six 4 in. blast burners in the back wall of the furnace at the bottom of the combustion chamber. The burners are supplied with gas and air through mixing tubes which enter the furnace at the back. Additional air is supplied directly to the combustion chamber through 50 secondary air inlets uniformly spaced over the back wall of the chamber. The flow of gas and air to each burner and to each secondary air inlet is regulated by individual valves provided with graduated scales so that the valve settings may be duplicated accurately.

Gas is supplied to the furnace through a 6 in. pipe connected to the street mains. Air is supplied to the burners and to the secondary inlets by a blower driven by an electric motor. The entire gas and air supplies are each controlled by valves in the main connections.

Temperature Measurements

The apparatus for measuring the temperatures within the combustion chamber consists of five thermocouples symmetrically distributed over the exposed surface of the test panel, the instruments for indicating the temperatures, and a switch-board and connections for placing any of the thermocouples in circuit with the instruments. The thermocouples are inserted through openings in the back wall of the furnace and located 6 in. from the face of the test panel. The connections are such that the position of the couples can be maintained in case of deflections in the test panel. Mercury thermometers are suspended near the cold junctions of the thermocouples for use in ascertaining the corrections to be made in the temperature readings.

The apparatus for measuring the temperatures on the unexposed face of the test panel consists of five mercury thermometers symmetrically distributed over the surface of the test panel opposite the thermocouples in the furnace. The bulbs are in contact with the surface of the test panel and are protected from outside influences by shields secured to the surface of the test panel. The temperatures are read directly or by a telescope mounted at a convenient distance back of and opposite the middle of the test panel.

The Walls Tested

The walls covered by this report consisted of a single wall of Gunite about one inch thick supported by 2 in. x 4 in. wooden studs spaced about 16 in. on centers; a single two inch wall of Gunite with supports at intervals of from 4 ft. to 7 ft.; and a double wall consisting of two 2 in. Gunite walls, connected at intervals of from 5 ft. to 7 ft. with solid Gunite studs. All walls were reinforced with expanded metal.

In the investigation of the single one inch wall the fire and hose stream test sample was subjected to the standard heats (maximum 1,500 degrees F.) for 36½ minutes, and to a water test of 3 minutes. and the report states:

"The panel was securely in place at the end of the test and still capable of preventing the passage of flame through or around the wall. The Gunite slab had separated from the wood studding so that the nails near the middle of the studs were generally drawn clear of the studs over the center region of the sample. The outer surface of the Gunite was somewhat dehydrated, but in general the dehydration did not extend through. The outer surface of the studs were charred quite generally and the felt carbonized except in places."

In the panel to be subjected to the fire endurance test it is stated that "it was early noted that the nails holding the mesh to the studs did not pull with the expanding slab, resulting in a spalling of the slab to such an extent as to allow the passage of flames," with the result that the fire was withdrawn at the end of 32 minutes. The report in referring to this phase of the investigation states:

"In the single test in which no spalling occurred the Gunite and expended metal drew away from the wood studding by pulling the nails which held the expanded metal to the studding. When it is considered that the nails are 3 in. long and spaced comparatively closely together the force developed by the expanding Gunite and reinforcement may be realized."

Other Samples Tested

The other samples tested at the Laboratories consisted of two slabs of the hollow double wall type each about 10 feet wide by 11 feet high. The studs were spaced on 6 ft. 10 in. centers thereby leaving a short space of about 18 inches on each side adjacent to the brick enclosure walls. The sample subjected to the fire and hose stream test was with-drawn from the flames at the end of the specified hour duration; while the fire endurance test sample remained exposed to the flames for a period of 4 hours and 15 minutes, at which time one of the thermometers on the unexposed face reached 340 degrees F., although the average temperature of the five points was 263 degrees F. at that time. The heat of the exposed face at the time was about 2,030 degrees F.

No tests were made by the Laboratories on single 2 in. walls, but as the authorities of Columbia University were preparing tests on Gunite slabs (A) 1½ in.; (B) 2¾ in., and (C) 2¼ in. thick it was arranged to carefully study and co-ordinate these results with those obtained at the Laboratories in order to incorporate this information in the report. These slabs were designed and reinforced to support loads of 40 lbs. per sq. ft., on a 6 ft. 3 in. span (Slab A); 150 lbs. per sq. ft. on 8 ft. 6 in. span (Slab B) and 150 lbs. per sq. ft. on a 6 ft. 10 in. span (Slab C). Temperature readings on the top and bottom of the slab were carefully measured. The heat of the exposed side closely approximated the standard curve until it reached 1,700 degrees F. when it was kept at that temperature for the period of the test (2 hours 56 minutes). The unexposed face of slab A which was 1½ in. thick reached a temperature of 300 degrees F. at 1 hour and 44 minutes, while slab C. (2¼ in. thick) reached the temperature at 1 hour and 52 minutes.

It had been the original intention to subject all of these slabs to an exposure of 1,700 degrees F. for 4 hours, but at 2 hours 56 minutes, a hole about 24 inches in diameter broke through slab (B), resulting in drawing the fire. Examination of the stresses showed that the steel reinforcing mesh in this slab was subjected to a strain of 19,400 lbs. per sq. in. under the imposed load of 150 lbs. per sq. ft., and as the failure was clearly in the melting of the steel it would seem to indicate the inadvisability of designing slabs of this type with such high stresses. After the slabs had been allowed to cool, Slab (A) was loaded to 200 lbs. per sq. ft. and Slab (C) to 600 lbs. per sq. ft., both without destruction.

The Impact Test

A very interesting phase of this investigation was the impact test to which the two double wall samples were subjected. A standard 15 ft. I beam 16 feet long was provided with standard connecting angles on the head, and so placed that a hinged footing at the floor was 13 feet from the wall. This allowed the head of the beam to fall freely against the wall without rebounding, it being thought to approximate as nearly as possible falling beams in case of fire. It is interesting to note the summation of these tests as noted in the report.

"The results obtained in these tests show that Gunite double wall construction is capable of resisting fairly heavy impacts from falling members without the formation of openings through back slabs, and that it possesses this property after it has been exposed to severe fire for fairly long periods. The heavy reinforcement employed yields sufficiently to absorb much of the impact and at the same time offers sufficient resistance to prevent the falling members from penetrating deeply into the wall. The reinforcement also serves to transmit the force of the impact to surrounding areas. The reinforcing studs present a high degree of resistance to impacts, and are so protected by the slabs that they are not easily affected by heat. The combined resistance of the reinforced Gunite slabs and Gunite studs increases the impact resistance of both of these parts."

An illustration of the thoroughness practiced by the engineers of the Laboratories in compiling a report of this type is the field examination. The report shows that not only do they investigate the "Practicability," "Durability," "Strength," "Uniformity" and "Fire Retardant Qualities" of the samples as evidenced by the Laboratory tests, but investigations were made of field installations of Gunite construction of similar or pertinent character, and reported on as follows:

Gunite Stucco

"The examination showed that Gunite stucco on the outside of a building is not materially affected by exposure to weather, except for a few hair cracks, the exposed Gunite in all cases being evidently in good condition."

"At one place where the Gunite covering of steel columns and girders was being removed for the installation of additional travelling cranes, it was noted that the expanded metal and the steel girders and columns in direct contact with the Gunite showed no effects of corrosion."

"In all of the constructions examined the Gunite appeared to be uniform in quality."

Messrs. Band & Cole, 775 Bank Street, Ottawa, Ont., have secured the contract for installing a steam heating plant for the Bell Street Methodist Church at a cost of $4,125. The same company are installing a plumbing and hot water heating system in an Ottawa apartment being erected by A. E. Shaver. Messrs. Band & Cole report business as satisfactory.

The Northern Construction Company and Fraser-Brace, Limited, the contractors on the power plant for the Manitoba Power Company, state that their work is ahead of schedule time.

Suggestion For Community Heating

Novel Scheme for Municipally Controlled Heating Plant Presented by Wm. Hurst, Winnipeg Engineer—Method Adaptable to Any Town With Water Service and Power Plant

Prospects of a fuel shortage this winter are causing a good deal of discussion and thought in the Winnipeg city council, so much that a committee has been formed to deal with the problem. In addition to assuring the Civic Utilities of sufficient fuel for the winter, this committee is also working upon a plan to make sure enough, coal is in sight to provide for the needs of the citizen.

The committee has been approached by William Hurst, connected with the engineering and construction business of Winnipeg, with a plan which he states will not only eliminate all possibilities of future fuel troubles, but also provide a means of community heating at a minimum expense by utilizing present water distributing systems for the furnishing of hot water for heating purposes.

The groundwork of Mr. Hurst's plan is that if the city is able to supply light water and power it should be equally feasible to also furnish heat during the winter months. This would eliminate individual plants and provide a safer, cleaner and more economical method of heating at considerably less expense.

In presenting his plan to the fuel supply committee, Mr. Hurst explained that it embodies the utilization of present domestic water systems and that to carry out his plan, it is only necessary to evolve a way of heating the water at the reservoir and distributing it through existing mains and pipes to users who would be charged for it exactly as they are now charged for domestic water, gas and light. This, Mr. Hurst claimed, was a simple problem to the engineering profession. Various methods of community heating had been advocated from time to time but these were more or less impractical owing to heavy cost of installing apparatus, but under his plan hot water could be distributed at a minimum cost because existing pipes could be utilized for supplying hot water for both heating and domestic purposes. In the summer months the usual cold water could be furnished without the need of any change in existing equipment. The memoranda prepared by Mr. Hurst covering the broad outline of his proposed plan of community heating by hot water reads as follows:—

Memo Re Heating Proposition

"William Hurst of the Hurst Engineering Company believes that he has reached a solution of the heating problem so far as it affects the City of Winnipeg (and others). Two main factors enter into this proposition insofar as the city is concerned. The first is a bountiful supply of electrical energy, there being thousands of horsepower going to waste all the time. The next favorable point so far as the city is concerned is the fact of the unlimited supply of water which can be delivered, and if necessary even wasted, in the carrying out of his proposed scheme.

"The city in the summer time is engaged in delivering cold water for the use of the inhabitants. Mr. Hurst's proposition is that in the winter time by the use of coal or electrical energy large volumes of water can be heated and distributed to the citizens through the mains the same as the cold water is now being distributed through the mains during the whole of the year. This means that wherever a water service exists a continuous stream of hot water can be delivered in each home in the city with the proper radiation equipment in the rooms. Mr. Hurst contends that after the hot water is passing through the service pipes, the clay will bake around the outer circumference of the pipe, and will preserve the heat after same is in operation, and will continue to bake, making an insulator from the cold clay surrounding this pipe, which is below the freezing surface.

"If such a scheme could be effectively carried out there would be a saving to the citizens of Winnipeg of millions of dollars worth of coal, irrespective of the question of stoking and handling the ashes. In addition to that the fire insurance hazard would be materially reduced because there would be no individual heating plants in operation in the thirty thousand homes throughout the city. Further, it would be immaterial whether the house was a large one or a small one the service would be just the same, the temperature the same and there is only the question of the necessary radiating pipes. The cost can be easily calculated for no citizen would object to even paying the city as much as his fuel bill is when he is saved the labor of stoking and clearing away the ashes.

"A market is thus provided for the surplus power and also a market for considerable additional water.

"Somebody may raise the question of what about the drinking water if hot water is to flow through the taps. The answer is simple—the amount of cold drinking water required is small and as we have very cold weather for about six months of the year it is not a difficult problem to get the water cooled down to a temperature for drinking purpose. In other words, the City would undertake as a public utility, for supplying cold water in the summer time and hot water in winter time, both for heating and all other purposes.

"Mr. Hurst's idea means the discharge of the condensed or cold water, not back into the system, but into the sewer which would be at a higher temperature than normal, and this could not have anything but a beneficial effect in sewer flushing, and with millions of gallons being discharged would probably keep the sewers in better condition than they are in the winter time at present.

Advantages

1. Saving of enormous coal bills.
2. Saving in stoking and furnace operation.
3. Saving in connection with the carrying out of ashes by the householder and collection of same by the City.
4. Enormous reduction in the fire risk, and should be a reduction in insurance premiums.
5. Available market for surplus power.
6. No longer would it be necessary for the citizens

to pay enormous coal bills to the United States or even Canadian coal mines.
7. Sterilizing of the water by heating it sufficiently to destroy germs.
8. The use of the pumping plant and distributing plant now in use.
9. Saving of fire fighting hose at time of fire as with hot water passing through, there will be no frozen hose.
10. The saving of street cleaning, on account of hot water which passes through the sewers, this melting the snow with no cost of labor to any extent.

Electricity has been called "white coal." why not use it to the fullest extent?"

Genuine Service Faithfully and Conscientiously Rendered

An Address by Ernest T. Trigg, President of the National Federation of Construction Industries

Out of the great World War have come many lessons for the good of mankind. If it were not so, all of the sacrifices and loss which it entailed would have been for nothing. I think I am but voicing a consciousness which has come to all thinking business men, that one of the greatest benefits is the realization that **true and lasting success can come only as a reward for genuine service faithfully and conscientiously rendered.**

In trading, business, commerce, industry, or by whatever other name we choose to call our daily activities, if we but think of them rightly—we are serving others with the things we have or make and which they need, in order that we ourselves may be able to purchase and possess the things which are made by others and which we require. Down through all the ages, with a constant increase in population and the needs of mankind, there has gradually developed a business system, steadily multiplying in its ramifications and its interdependence. Once the then few inhabitants of the earth were sufficient each unto himself, but gradually those who produced more than they consumed exchanged their surplus for other products or materials. Step by step, but always based on this original principle, the system has developed to its present highly specialized state. Unfortunately, however, we seem to have reached a place where we have lost track of the real fundamentals of business and think of it, perhaps, too much as some highly technical thing full of secrets and mystery. I think of business, as previously stated, as **the doing on the part of each one of us, of our specialized part for the benefit of others, in order that we may be entitled to receive in exchange the products of their specialized activity or industry.** If we think of our daily activities in this manner, it just naturally makes the consideration a much more personal one and makes us realize that we can only expect to find favor with the rest of the public, who are busy producing other commodities and doing other things,—if that which we have to offer them is really something which they require and which serves an economic and useful purpose.

Let's think just a minute in the terms of the direct trading days: The man who then produced a surplus of anything which did not appeal to those with whom he expected to make exchange could not long exist himself, because unless others wanted his surplus, he in turn could not expect to enjoy theirs. And so, after all, **the real fundamentals of permanent business success are all wrapped up in the thought of service of a useful kind which gives to the public the things they want and need.** Our great industrial plants, our intricate financial institutions, our highly developed transportation systems, and the powerful shipping interests of the world which have linked all countries together and made available to each the products of the others,—are merely tools which have been shaped out of the necessities of mankind and represent the best current adaptation to the needs of all the people. It was thoughts along this line that prompted the selection of the subject of my talk today, namely:

"Paint and the Public"

Surely, we all know that the public has no interest in industry because its members desire, selfishly, to dispose of their products to the public at a profit to themselves. It is the fact that the public requires the products of our industry for its own best welfare which makes possible the constantly increasing volume of trade which the Paint and Varnish Industry is doing. It is, of course, true that all property owners do not realize to the fullest extent the great benefit which our industry is to them, any more than did the public once realize the great economic service which could be and has since been rendered it by the telephone, electricity, or any other one of the many conveniences, comforts and useful devices, materials and methods which have been given to us, one at a time, down through the centuries. Because of this lack of knowledge, it is the responsibility of our industry, I believe, to keep consistently before the public as a whole, the sound, economic value to it of the products we make, not only through advertising and the printed word, but by the strongest and most intelligent sales effort.

The great taxable wealth of our Nation is its construction of various kinds. For several years prior to the war the annual addition to the Nation's wealth through new construction aggregated between three and four billions of dollars. Our construction development fell off tremendously during the period of the war and, in fact, since the war up to this year. The result was an accumulation of a great shortage throughout the country. A revival of construction has occurred this year,—in fact, the amount of work under way in many communities is much in excess of the ability to produce. This is notably true insofar as the supply of skilled labor is concerned. For some weeks or months there have actually been conditions where employers in some building trades have been bidding against one another for such labor as was available. Let me quote from a bulletin issued under date of July 3rd 1922, by the National Industrial Conference Board:—

"On the whole the expedient of increasing wages to draw out necessary labor is being used. Such increases, while they give an employer a temporary advantage, force similar increases in other plants, and lead to a steady pyramiding of wages and a repetition of the vicious circle experienced during the war period. The labor shortage, therefore, threatens to develop into a national problem of considerable importance."

This is an unhealthy condition. I do not say this from the standpoint of opposition to the wage earner securing the highest possible wage up to the point where it is not against the interest of the public. My reason for saying it is that in the broad sense the wage earner pays his own wages, and excessive amounts paid to him on the one hand in the shape of wages, must inevitably find a reflection in excessive amounts which he must spend on the other hand, to live up to his usual standard.

Lime Stucco

Lime stucco is a mixture of properly prepared lime putty, which may be made from either quicklime or hydrated lime, sand and water, with or without the addition of a small amount of cement. Hair or fiber may be added to assist in forming the key, depending on the style and character of the backing. Coloring matter may be added to obtain the tone desired, although more frequently color effects are obtained through the use of selected sands. Different colored aggregates, either fine or coarse, may be used for obtaining various effects of color and surface texture.

Court House at Prince Rupert

Contract Awarded and Work Will Start Immediately

With the placing of the contract for building of the new court house at Prince Rupert, B. C., with McDougall & McNeill, of that city and Vancouver, the northern seaport is assured of a very fine addition to its public buildings in the immediate future. The general contract was let for a sum in excess of $400,000 and a number of smaller contracts in connection, of which the most important was for heating, will bring the total cost considerably above that amount.

The building will consist of two storeys and basement, and will cover a ground space of 159 ft. x 56 ft. The basement will contain, in addition to boiler and fuel rooms and janitor's quarters, a number of store rooms, several cells, and offices for the police and agricultural departments. The main office on the ground floor will be the Land Registry, which is to be about 34 ft. x 51 ft. in size. Other large public offices will be the Government Agent's and the Forestry Department, each 21 ft. x 42 ft., while other rooms will be devoted to the Water Rights Department and to use as private offices for certain of the officials.

The first floor has the court room as its main feature, which will be directly over, and the same size as the Registry Office on the ground floor. The various court offices and quarters for the Public Works Department and the Department of Mines take up the remainder of the space on this floor.

The building will be of reinforced concrete construction, with outside finishing of Clayburn red tapestry brick and sandstone trim. The roof will be Barrett specification. The interior finish will be of the best throughout, and the main staircase will be very handsomely finished with marble treads, risers, strings and dado, while the main newels will also be in marble, the intermediate newels being of cast iron to special detail. All corridor floors and lavatories will have marble terrazo floors, and lavatory stalls will be of marble panels with nickeled fittings. The court room is to be finished with oak panelling, and the judge's room panelled with mahogany.

Equipment of the building will include a complete vacuum cleaner system, a telephone exchange and lighting system, all controlled from a switchboard in the basement. The heating will be on the vacuum system (steam); two return tubular boilers are being installed to take care of the building in this respect.

Handy Hints

How often have you wished for a good cement for wood, marble, metal, or glass? It is not necessary to buy a high-priced article, for such a cement may be very easily prepared from material that may usually be found in the house.

Take four parts of fresh curd from sourmilk and mix it thoroughly with one part (by volume)of hydrated lime. If hydrated lime, which is a dry powder, is not available, it may be prepared by slacking a little fresh quicklime with just enough water to make it crumble and form the dry powder. As this cement sets very rapidly, only a limited amount should be prepared at any time.

Before applying this cement to wood or marble it is advisable to coat the surface with a solution made by dissolving some curd in ammonia or borax solution. This will fill the pores and make the cement stick better.

Powdered quicklime, mixed to a paste with white of egg also makes a quick and hard-setting cement which is suitable for use on such materials as ivory, marble, glass, porcelain.

New School at St. John, N. B.

The contract for the construction of the new school in West St. John, N. B. has been awarded to H. O. Clarke, of St. John, the lowest tenderer. The contract price is $122,000. The building is to contain twelve class-rooms, an assembly hall and gymnasium. Mr. Clarke the successful bidder, is a son of A. R. C. Clarke for many years engaged in business as a contractor in St. John and now associated with his son. The younger Mr. Clarke has been engaged in the contracting business for the past three years. This is his first large contract. He served in the Canadian Expeditionary Force during the war and before he joined the forces, was employed with his father. He is one of the best of the St. John semi-professional baseball players and is the first baseman for the St. Johns, one of the two local semi-professional clubs. Although now living in the city proper, Mr. Clarke lived most of his life in West St. John. Work on the new school, which will be in the rear of the present Albert School, has started and it is expected to have the building ready for occupancy in October. Five dwellings were removed to secure a site for the building.

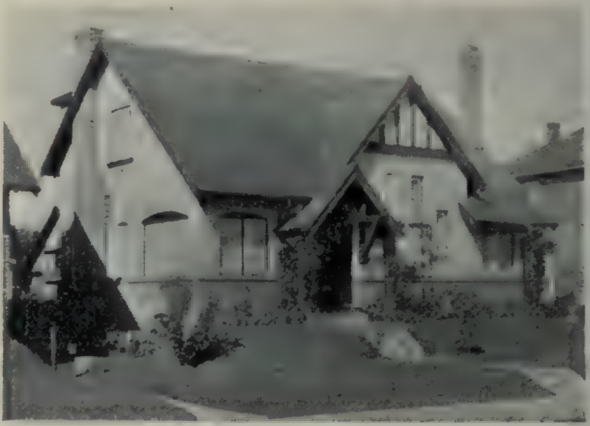
The Standard Steel Construction Co., Ltd., of Welland, Ontario, have just issued a new stock list of all the steel products which they warehouse for quick delivery, including structural steel shapes, steel plates, bars, etc. This new booklet also has very useful information relative to weight tables, etc.

The Contract Record's

Weekly House Suggestion No. 33

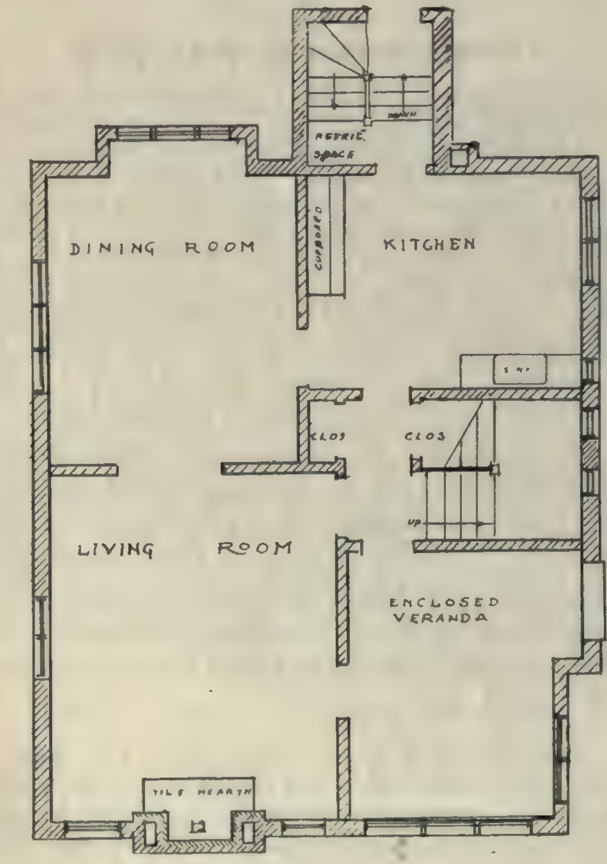
We are showing this week another of Mr. H. Addison Johnston's attractive homes, in the Beach district of Toronto. This is a six-room, brick and stucco residence, neatly finished with wood trim, especially effective in the little gable roof over the main entrance at the front. As seen in the accompanying illustration, the walls are of red face-brick to the sill of the windows on the first floor, and stucco above. All windows are of the casement type, finished in white enamel. The front entrance is on a large enclosed verandah, which has a direct entrance on the living room and also an entrance to the right on the hall. As will be seen by a glance at the ground floor plan, very little space is taken up by the hall in this layout. The living room, with its beautiful large brick fireplace is the feature of the first floor plan. It is connected with the dining room by a wide trimmed opening. The latter room is conveniently situated to the kitchen and hall, and has a beautiful large bay window in the right wall. The kitchen is complete with built-in labor-saving features and is finished in white enamel. The floors and trim throughout the first floor are of oak.

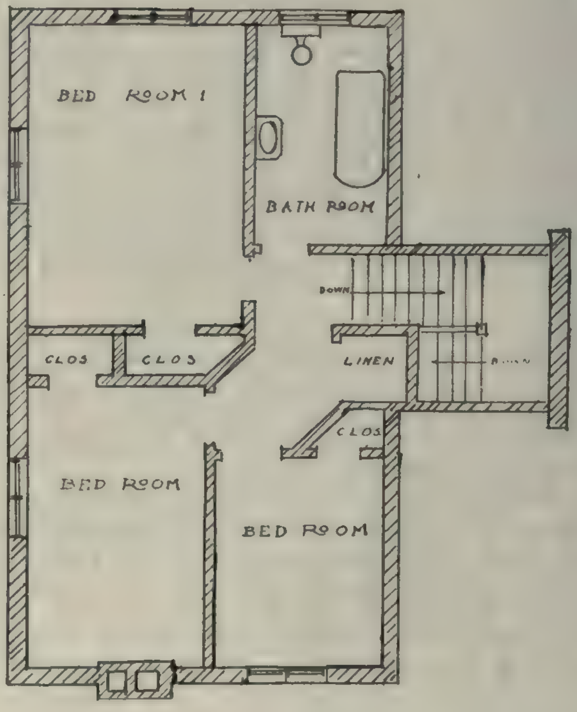
There are three good-sized bedrooms and bathroom on the second floor. The bedrooms are all floored with oak and trimmed with pine, white enamelled. The bathroom is finished in white tile.



The basement consists of furnace room, coal space, laundry and fruit storeroom, and extends under the full area of the house.

Mr. H. Addison Johnston, 13 Silver Birch Ave., Toronto, designed and built this neat little residence.





Mainly Constructional

East and West—From Coast to Coast

The Imperial Oil Limited, it is stated, intend erecting a $2,500,000 oil refinery in Calgary.

The ratepayers at Port Dover, Ont., recently approved of a by-law authorizing the expenditure of $65,000 for water works purposes.

A by-law to raise $40,000 for the construction of an addition to the main school on Bertie Hill, at Bridgeburg, Ont., was passed recently.

The Board of Trade at Ottawa has formed a traffic bureau which will be under the direction of Mr. Arthur M. Macleece, formerly with the Imperial Munitions Board.

The Belgian Industrial Co. Ltd., of Shawinigan, P. Q., intend erecting a dam on the Grand Bostonnais River, at the limits of the lake known under the same name.

Excavation has begun on the foundation of the Dominion Combing Mills at Trenton, Ont. An excellent site has been secured near the Trent river and the C N.R. Railway.

The Winchester Dye Co., who have located their plant at Trenton, Ont., and who expect to manufacture several colors, have almost completed their plant and will be in production in the course of a few weeks.

The total number of permits issued at Kitchener for the first six months of this year was 597, representing a property valuation of $1,716,065. This is far in excess of any total for the half year in the records of the city.

Smith Falls, Ont., is to have a chemical industry. The Manufacturers Chemical Company, incorporated for $100,000 have secured a satisfactory site where they intend to build a plant for the manufacture of chemicals for the dye industry of Canada.

The Housing Commission at Sydney, N. S., made a tour of inspection of the houses being erected for the commission. There are forty-two houses under construction and more willl be started soon. The commission are highly pleased with the work being done and the quality of material used.

The sum of $50,000 has been provided in the program of the Montreal Harbor Commission for preliminary work on the proposed bridge structure over the Montreal Harbor, connecting the city proper with Longueuil. This work will consist of borings, soundings, preparation of plans, estimating of costs, etc.

Because their wages were reduced from $250 per month to the rate of $1 per hour for eight hours per day, the crews of six steam shovels on the Hydro intake at Chippawa, Ont., have gone on strike. They were employed by the Castellani Construction Company, of Toronto. The men claim that the reduction in their wages amounts to about $2 per day.

The Master Painters and Decorators of London and St. Thomas held a joint picnic at Pinafore Park, St. Thomas, recently, which included a fine program of sports, supper in the pavillion and a big dance in the evening. Mr Fred Pace, of London, directed the sports which included a number of jumping and racing events and a baseball game between the representative teams of the two branches, resulting in a 6-6 tie. A very enjoyable day was spent.

The Hamilton entrance of the Toronto-Hamilton Highway was officially opened recently and also the local link of the Niagara-Hamilton Road. Rain interfered with the attendance to some extent, but there were hundreds of interested citizens present. After the opening ceremonies the party about two hundred in number attended a banquet as guests of the city at Wabasso Park Pavilion, where further addresses were made.

A plan for a water system to serve the municipalities of Vancouver, Point Grey, South Vancouver, Burnaby, North Vancouver and the districts of North Vancouver and West Vancouver, was presented at a meeting of the mayors, reeves and councillors of the above municipalities, held at the city hall in Vancouver recently. Mayor Tisdall, of Vancouver, who outlined the scheme, declared it would mean the elimination of the possibilities of any future water shortage,and that the entire scheme would not require the expenditure of any more than $1,000,000 to execute, existing mains and other facilities being incorporated in the project.

Suggestions that the district from the Soo to Sudbury and the district around Port Arthur and Fort William be organized with a view to devoting expenditure of more money by the province of Ontario to better the roads through this section, and to conduct a campaign for the building of a highway from the Soo to Port Arthur along the north shore of Lake Superior, were made at the Good Roads meeting held at Bruce Mines recently following the arrival of the motor touring party of the Soo Automobile Club. The speakers were all of one mind, that Northern Ontario needs good roads and that good roads it must have.

Personal

Mr. Wallace Allen, sanitary and heating engineer, has taken up residence in Ottawa, at 15 Euclid Avenue, and will carry on business in the above capacity from that address.

Hon Ernest Lapointe, Minister of Marine & Fisheries, recently visited Montreal and inspected the harbor, its facilities and methods of operation. Mr. Lapointe was accompanied on his tour of inspection by Mr. Alexander Johnston, Deputy Minister of Marine and Fisheries, Mr. V. W Forneret, superintending engineer of the St. Lawrence Ship channel, and several members of the Harbor Commission.

Professor Ernest A. Stone, Ma. E., formerly for three years dean of engineering and professor of civil engineering at the University of New Brunswick, has been appointed to the chair of mathematics at King's College. Professor Stone came to the University of New Brunswick in 1908 as professor of civil engineering from Dalhousie University, succeeding Professor Samuel W. Perrot, B.A., B.A.I. His departure from U. N. B. occurred in 1911 when he was suceeded by Professor J. A. Stiles, B.Sc, now Assistant Boy Scout Commissioner for the Dominion, at Ottawa. Professor Stone had following his residence here, resided in Vancouver and Montreal.

Obituary

Napoleon Giroux of the firm of N. Giroux & Son, cement block manufacturers, Tilbury, Ont., died recently following a few weeks' illness from sunstroke. Born at St. Joachim, 52 years ago, Mr. Giroux lived in that vicinity until about ten years ago, when he and his family moved to this town.

Trade Incorporations

Toronto Simonizing Co. Ltd., with head office at Toronto capital $40,000, to carry on the business of dealers in paints, varnishes, enamels, etc.

Aylmer Construction Co. Ltd, with head office at Aylmer. P. Q., capital $20,000, to carry on the business of building contractors, specializing in houses.

The Rambusch Decorating Company, of Canada, Limited, a corporation created under the laws of Nova Scotia, has been granted authority to operate in the province of Ontario.

CONSTRUCTIONAL ACTIVITY

Period of August 23 to August 29, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Burlington, Ont.
Town Council plan construction of storm sewer on Brant St. MacKay & MacKay, Engrs., Home Bank Bldg., Hamilton.

Cloverdale, B. C.
Plans are being prepared for roadwork to cost $30,000 for Prov. Gov't.

Collingwood, Ont.
Town Council plan construction of waterworks. A. Mayer, clerk.

Elma Twp., Ont.
Geo. Lochead, clerk Twp. Council, Atwood, Ont., will receive tenders until Sept. 2nd for tile drainage work.

Fort Erie, Ont.
Plans are being prepared for sewer for Town. A. E. Seaton, clerk.

Lachine. Que.
City Council plan construction of pavement on 6th Ave., also improvements to aqueduct. E. Leduc, secy.-treas.

Montreal, Que.
City Council plan construction of 48" watermain from Pointe St. Charles to pumping station. S. Fortin, Engr.

Mornington Twp., Ont.
Twp. Council contemplate drainage improvements. W. J. Zoeger, clerk, Newton, Ont.

Prairie Siding, Ont.
Kent County Council contemplate rebuilding drainage pumping station at cost of $15,000.

Trafalgar Twp., Ont.
W. A. McLean, Deputy Min. Dep't. Pub. Highways, Prov. Gov't., Toronto, will receive tenders until Sept. 11th for about 5½ miles of waterbound macadam base co,urse. Plans with Dep't., and G. C. Greig, Res. Engr., Waterdown, Ont.

Woolwich Twp., Ont.
W. J. Snider, Twp. Clerk, Conestoge, Ont., will receive tenders until Sept. 5th for construction of Municipal Drain No. 4 and reclaiming Municipal Drain No. 1.

CONTRACTS AWARDED

Beamsville, Ont.
General contract for bituminous penetration pavement for Prov. Gov't. is awarded to Peter Robinson, Beamsville. This was reported in our issue of Aug. 23, in error, as Tarvia pavement.

Burlington, Ont.
General contract for macadam road on Burlington Ave. for Town is awarded to Frid Construction Co. Ltd., Clyde Block, Hamilton. MacKay & MacKay, Engrs., Hamilton.

Chilliwack, B. C.
General contract for sewerage system costing $26,000 for City is awarded to Hodgson, King & Marble, 508 London Bldg., Vancouver. C. Brackenridge, Engr., Board of Trade Bldg., Vancouver.

Galt, Ont.
General contract for construction of pipe line costing $8,000 under Grand River for City is awarded to E. C. Stewart & Sons, Port Dover. W. H. Fairchild, Engr.

North Dorchester Twp., Ont.
Wm. Eden, Springfield, Ont.. has general contract for construction of drain for Twp. Council.

Ottawa, Ont.
Contract for construction of sewer costing $80,000 for City is awarded to Dominion Lock Joint Co., Hamilton, Ont.

Penetanguishene, Ont.
General contract for reinforced concrete pavement for Town is awarded to Archibald Construction Co., 122 Deleware Ave., Toronto. James, Proctor & Redfern Ltd., Engrs., Excelsior Life Bldg., Toronto.

Regina, Sask.
General contract for construction of pavements, curbs and gutters on 2 streets for City is awarded to Bitulithic & Contracting Ltd., 601 Trust & Loan Bldg.

Timmins, Ont.
Leo Mascioli, Timmins, has general contract for construction of sewers and watermains costing $40,000 for Town. J. F. Henderson, Engr.

Toronto, Ont.
General contract for construction of concrete roadway costing $10,000 in Cherry St. yards for C. N. Rlys. is awarded to Lumsden Engineering & Transport Co., Lumsden Bldg.

Woodbridge, Ont.
General contract for waterworks system costing $30,000 for Town is awarded to Standard Construction Co., Mimico, Ont. James, Proctor & Redfern Ltd., Engrs., Excelsior Life Bldg., Toronto.

Railroads, Bridges and Wharves

Grondines, Que.
R. C. Desrochers, secy. Dep't. Pub. Works, Dom. Gov't., will receive tenders until Sept. 12th for construction of wharf. Plans with Dep't., and at offices of Dist. Engrs., Post Office Bldg., Three Rivers, Post Office Bldg., Quebec, and Post Office, Grondines. Accepted cheque for 10% of tender required.

Lansdowne Twp., Ont.
R. J. Green, Twp. Clerk, Coperton, Ont., will receive tenders until Sept. 4th for construction of steel bridge. over Lyndhurst River.

Magog, Que.
J. O. Donegan, secy.-treas., has plans and will receive tenders, no closing date set, for construction of iron bridge. Plans also with I. E. Vallee, Engr., Parliament Bldgs., Quebec, Que.

Montreal, Que.
Tenders will be called for extension to King Edward Pier to cost $450,000 for Harbor Cmsn. T. W. Harvie, Chief Engr.

Preliminary plans are being prepared for bridge to cost $10,000,000 from Montreal to South Shore for Dom. Gov't., Dep't. Pub. Works.

St. Constant, Que.
D. Corbeil, secy.- treas., has plans and will receive tenders, no closing date set, for construction of reinforced concrete bridge for Municipal Council. Plans also with I. E. Vallee, Engr., Parliament Bldgs., Quebec, Que.

CONTRACTS AWARDED

Chippawa, Ont.
General contract for highway bridges over Chippawa Canal at Lundy's Lane, Portage Rd., and Thorold Rd., for Hydro Electric Cmsn. of Ontario, University Ave., Toronto, is awarded to Campbell & Lattimore, C.P.R. Bldg., Toronto. Contracts for reinforced steel and structural steel are placed with H. A. J. Aldington, 1977 Queen E., Toronto, and Hamilton Bridge Works Co. Ltd., Bay St. N., Hamilton.

Dorchester, N. B.
General contract for bridge costing $11,000 for Prov. Gov't. io awarded to College Bridge Constduction Co., College Bridge, N. B.

Galt, Ont:
Additional contracts for rly. station costing $19,000 fof Lake Erie & Northern Rly., are: Stone, (supply), Ritchie Cut Stone Co. Ltd., 191 Grant Ave., Hamilton; lumber and millwork, Mickle Dyment & Son, 284 Colborne St., Brantford; roofing and tinsmithing, Brown Jarvis Co., 9 George St., Brantford; electrical, Galt Electrical Gas Fixtures Co., Galt; plumbing and heating, F. J. Short, Galt; brick (supply) Milton Pressed Brick Co., Milton; Plastering. A. Loker. Galt. F. H. Midgley, Tngr.

St. David, Que.
L. P. Gagnon, St. David, has general contract for construction of reinforced concrete bridge costing $6,900 for Municipal Council.

Toronto, Ont.
Contracts for steel sash, skylights, roofing, tin clad doors, rolling steel doors and revolving door for Eglinton Ave. car barns for Toronto Transportation Cmsn., are awarded to The A. B. Ormsby Co. Ltd., 48 Abell St.

Wilmot Twp.. Ont.
Waterloo County Council awarded following contracts for construction of steel bridge costing $30,000: Steel construction, J. J. Hill, Mitchell, Ont.; abutments, Alex. Fraser, New Hamburg, Ont.

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director

HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U.S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 **Toronto, September 6, 1922** **No. 36**

The Most Foolish Spectacle in the World

One does not need to be a philosopher to be moved to remark on the utterly foolish spectacle of a vast army of workmen out of employment over a period of months because their wages are not big enough. The situation is idiotic and contradictory.—Men urge the necessity of higher wages so that they may live comfortably but failing that they can live, for months, comfortably (apparently) on nothing at all.

We have been looking, in the past, too much at the cause of strikes and too little at the effects. It is safe to say, we believe, that much more misery, more actual deprivation, is suffered by the strikers and their families, during strikes, than during periods of employment. It is recognized as a fact that Labor rarely becomes recompensed, by the higher wages obtained, for the losses during their voluntary idleness, and it is certain that untold loss to the nation and inconvenience to the general public accompany and follow the majority of strikes.

The man on the street is only indirectly concerned with the causes of strikes, but the effects fall heavily on him. For this reason the day is fast approaching when we will demand that they be made impossible. Our daily life is a complex machine in which every class of citizen functions as a more or less essential part and no one class has a right to say, "I won't function to-day. I don't care if it does stop the whole machine." From the top to the bottom, from the big engine to the smallest bolt, each part of the machinery has its work to do and in accepting the responsibility of doing it must also undertake to carry on continuously.

There is no more foolish, uneconomic spectacle in the world to-day than a body of men earning nothing, producing nothing, whatever the cause of dispute, and whoever may be at fault, it is the duty of governments to make this condition impossible.

Signs Point to Increasing Activity

Crop reports from the Western Provinces are much more encouraging than for several weeks past and the indications are that the total will be well over three hundred million bushels of wheat, a still larger yield of oats and close to a hundred millions of bushels of other grains—more than seven hundred millions of bushels in all. Estimating the value roughly at an average of fifty cents, this means that the western farmers will have $350,000,000 added to their wealth. The situation in the other provinces is also encouraging. As an Ontario farmer expressed it the other day "Crops are as good this year as they were bad last year."

This is all good news for the building industry. Added to it is the further fact that the banks are gradually relaxing and showing indications of their returning confidence. It therefore looks as if money would be much "easier" during the coming Autumn and Winter. This, in time, will induce an industrial activity which must inevitably be followed by a demand for more buildings of the larger type. This year's activity has been chiefly in houses and it is very probable that next year will see a reversal—fewer houses and more factories, offices and warehouses.

There is an irrepressible feeling of optimism in the air, that augurs well for the year ahead of us. The building industry will profit with the rest, if the situation is handled with foresight and tact.

R ural Homes Not Up to Standard

One is always struck in moving up and down Canada, whether by train or motor, with the wonderful natural scenery. It is varied and restful, and always draws complimentary remarks from tourists. But it is equally noticeable that the creations of man in the way of churches, houses, out-buildings, etc., can lay no claim to bring in keeping with the wonderful hand of nature. The architecture is crude. The interior plans of the homes have regard neither for convenience, comfort nor art. The builders seem to be living in the past.

There is no excuse for unattractive homes in our rural districts. They are the result of ignorance rather than poverty—lack of appreciation of what a modern, convenient, comfortable, artistic home is really like. Land is so cheap that space is no object. Admirable locations are available with delightful settings. Yet we rarely see a country house that is really inviting. They all impress us as "places to live in" and we find the barns better planned, and more interesting in every way.

The thought had occurred to the writer that something might be done through our big National Exhibition. Every year hundreds of thousands of farmers come to Toronto to see what is new. Why not show them a Model Country House? It would not need to be expensive—rather the reverse—but it should be well planned out, built substantially furnished simply and have that "homey" atmosphere about it that is so rarely seen in rural houses and yet costs so little. Couldn't our Contractors' Associations join with the architects and do something along this line next year?

Annual Financial Review

The Annual Financial Review (Canadian) for the year ended June 1922 has just been issued by Messrs. Houston's Standard Publications, Stock Exchange Building, 84 Bay Street, Toronto. To the man or woman who has money to invest, whether in large or small amounts, this is a publication that may well pay for itself many times over during the year, for it is a carefully revised precis of facts regarding Canadian securities. The information contained includes the latest annual statements of banks, railways, public utilities, industries of every sort, loan and mortgage companies, mines, etc. Lists of bond and brokerage houses are also given, with the standard charges for buying and selling. In addition to the annual report of each company, there is also printed in nearly every case the record of the buying and selling transactions in the different stocks for a number of years, thus giving the investor an opportunity to judge, at a glance, whether the past history of a stock is such as to make it a suitable investment for his particular needs.

Contrary to the opinion held by most inexperienced investors, comparatively few fortunes are the result of speculation. Insurance companies tell us that 95% of our population are more or less dependent upon their relatives in their old age. This in spite of the fact that perhaps 50% of our people have developed in a greater or less degree the saving habit and have placed their money at one time or another in what they believed to be "investments." The secret of old age dependence must, therefore, be due to lack of knowledge about investments. For these reasons, it woud appear that no person with money to invest could do better than pay $10.00 for a copy of this Annual Review and make a careful study of its contents. If an investor has large quantities of money at his disposal this expense represents an infinitesimally small portion of the savings that may be effected through accurate knowledge. For the small investor, who's all is counted in thousands, it goes without saying that a high factor of safety is of prime importance.

Good Interest and Absolute Security

A liberal rate of interest with absolute security is the attractive offer made by the Minister of Finance to holders of the Canadian Government war loan bonds, maturing December 1, 1922. The offer is not made to investors generally, but only to the holders of the bonds soon to mature. The bonds to be retired, bearing interest at five and one-half per cent., will be exchanged for new bonds bearing the same rate of interest. See the advertisement of the Minister of Finance.

An international bridge connecting Edmunston, N. B., and Madawaska, Maine, was opened officially on September 4th., 1922.

Building in Canada During July

The value of permits issued in 56 Canadian cities during July 1922, as compared with that of June, 1922, and July 1921, is indicated by the following table.

ESTIMATED COST OF BUILDING WORK AS INDICATED BY BUILDING PERMITS.

City	June, 1922	July, 1922	July, 1921
	$	$	$
Prince Edward Island	**2,000**	**9,000**	**5,000**
Charlottetown	2,000	9,000	5,000
Nova Scotia	**340,940**	**260,324**	**240,115**
*Halifax	183,330	161,059	191,285
New Glasgow	18,400	3,500	3,900
*Sydney	139,210	95,765	44,930
New Brunswick	**341,005**	**289,875**	**131,750**
Fredericton	80,215	35,500	40,000
*Moncton	245,790	73,775	43,250
*St. John	15,000	180,600	48,500
Quebec	**3,559,752**	**3,545,870**	**2,510,893**
*Montreal *Maisonneuve	2,558,977	2.291.190	1,722,503
*Quebec	438,190	958,745	415,040
Shawinigan Falls	11,050	30,550	Nil
*Sherbrooke	136,000	132,000	75,000
*Three Rivers	57,900	35,600	9,500
*Westmount	357,635	97,785	288,850
Ontario	**8,005,913**	**7,322,188**	**4,859,597**
Belleville	15,300	2,500	9,000
*Brantford	48,370	149,610	36,675
Chatham	40,300	26,376	6,800
*Fort William	67,350	557,985	14,250
Galt	59,940	63,567	62,195
*Guelph	430,100	88,101	36,455
*Hamilton	440,575	521,500	481,400
Kingston	38,312	118,758	124,682
*Kitchener	561,045	107,026	70,660
*London	317,180	287,555	256,090
Niagara Falls	68,172	50,930	340,885
Oshawa	41,165	30,850	15,050
*Ottawa	422,800	782,760	205,529
Owen Sound	32,750	12,000	10,000
*Peterborough	29,389	34,570	159,278
*Port Arthur	29,770	31,228	5,156
*Stratford	62,433	31,157	5,890
*St. Catharines	151,088	43,170	73,720
*St. Thomas	16,550	44,925	4,990
Sarnia	77,525	83,119	83,438
Sault Ste. Marie	68,450	132,020	55,555
*Toronto	4,392,980	3,760,035	2,130,216
Welland	104,311	15,035	216,250
*Windsor	440,025	325,985	448,175
Woodstock	50,033	21,426	7,258
Manitoba	**1,387,174**	**1,051,115**	**1,108,545**
*Brandon	30,305	7,600	176,475
St. Boniface	107,869	50,915	62,020
*Winnipeg	1,249,000	992,600	870,050
Saskatchewan	**710,337**	**401,254**	**408,485**
*Moose Jaw	49,692	42,910	16,000
*Regina	381,100	208,199	302,060
*Saskatoon	279,545	150,145	90,425
Alberta	**423,125**	**482,490**	**199,745**
*Calgary	161,400	271,800	77,000
*Edmonton	246,975	193,405	92,300
Lethbridge	12,270	16,935	24,145
Medicine Hat	2,480	350	6,300
British Columbia	**1,029,434**	**912,910**	**717,995**
Nanaimo	14,710	680	7,095
*New Westminster	35,700	54,965	32,500
Point Grey	448,500	308,950	241,265
Prince Rupert	14,400	4,000	13,395
South Vancouver	64,640	44,495	91,275
*Vancouver	384,530	451,470	265,581
*Victoria	66,954	48,350	66,884
Total 56 cities	**15,799,680**	**14,275,026**	**10,182,125**
***Total 35 cities**	**14,465,200**	**13,332,328**	**8,881,299**

Correction

An editorial in our issue of August 23rd, page 833, under the heading "Iron and Steel Industry for British Columbia," third paragraph, mentions the amount of funds necessary for the undertaking as £30,000,000. This figure is a proofreader's error; it should have read £6,000,000.

Proposed Highway Bridge over River Des Prairies

Design of Structure to Connect Montreal North and St. Vincent de Paul—Estimated Costs and Quantities of Competitive Types

By A. LANGLOIS

The constantly growing traffic in and out of the Island of Montreal, renders new connections necessary between the Island and the neighboring districts. With the decided erection of the bridge at Isle Perrot at the west end of the Island, a highway connection has also become urgent in the north east for the accommodation of the large business and tourists, traffic toward the Laurentides through the new Montreal-Nominigue Provincial highway, as well as for the benefit of the inhabitants of the surrounding country which has an aggregate population of some 175,000.

The total length of the proposed bridge will be 1,500 feet exclusive of the approaches. Several projects have been submitted in connection with this highway improvement, and include all steel structures of various widths and a reinforced concrete bridge. A comparison of the estimated cost of the work according to the different designs is of interest.

Cost of Concrete Design

The reinforced concrete design consists of 17 spans of 88 ft. in length c. to c. of piers and has a width of 52 ft. inside the balustrade and comprises 2 six foot sidewalks, 2 roadways and double railway tracks; Figs. 1 and 2 show this bridge in elevation and in section. The river bed is rock.

The estimated quantities and cost of the concrete structure are:

Concrete in piers	9,880 cu. yds.	@	$7.50	$74,100.00
Forms	59,616 sq. yds.	@	0.20	11,923.00
Cofferdams (Bulk)				54,000.00
Concrete in ribs	3,230 cu. yds.	@	10.00	32,300.00
Reinforcing	432,000 lbs.	@	0.06	25,920.00
Pilasters (plain concrete)	500 cu. yds.	@	10.00	5,000.00
Concrete (brackets & walls)	2,560 cu. yds.	@	12.00	30,720.00
Beams & slabs	2,240 cu. yds.	@	11.00	24,640.00
Sidewalks & portals	667 cu. yds.	@	12.00	8,004.00
Abutments	6,760 cu. yds.	@	10.00	67,600.00
Balustrade	3,012 lin. ft.	@	3.00	9,036.00
Railing	520 lin. ft.	@	2.00	1,040.00
Paving	12,000 sq. yds.	@	4.00	48,000.00
Lamp posts	36 each	@	50.00	1,800.00
Excavation	48,500 cu. yds.	@	0.50	24,250.00
				$418,333.00

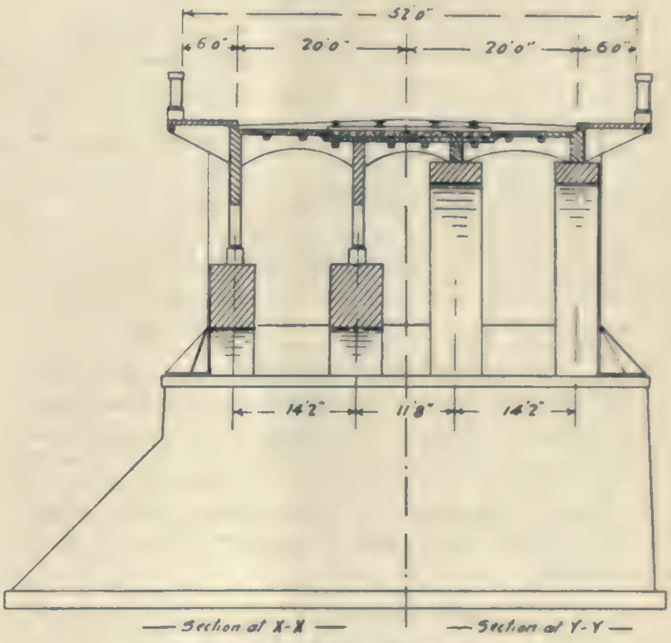


Fig. 2—Section of concrete design

The plans and estimates for the concrete bridge were prepared and submitted by Mr. J. E. Vanier, Civil Engineer and Architect of Montreal.

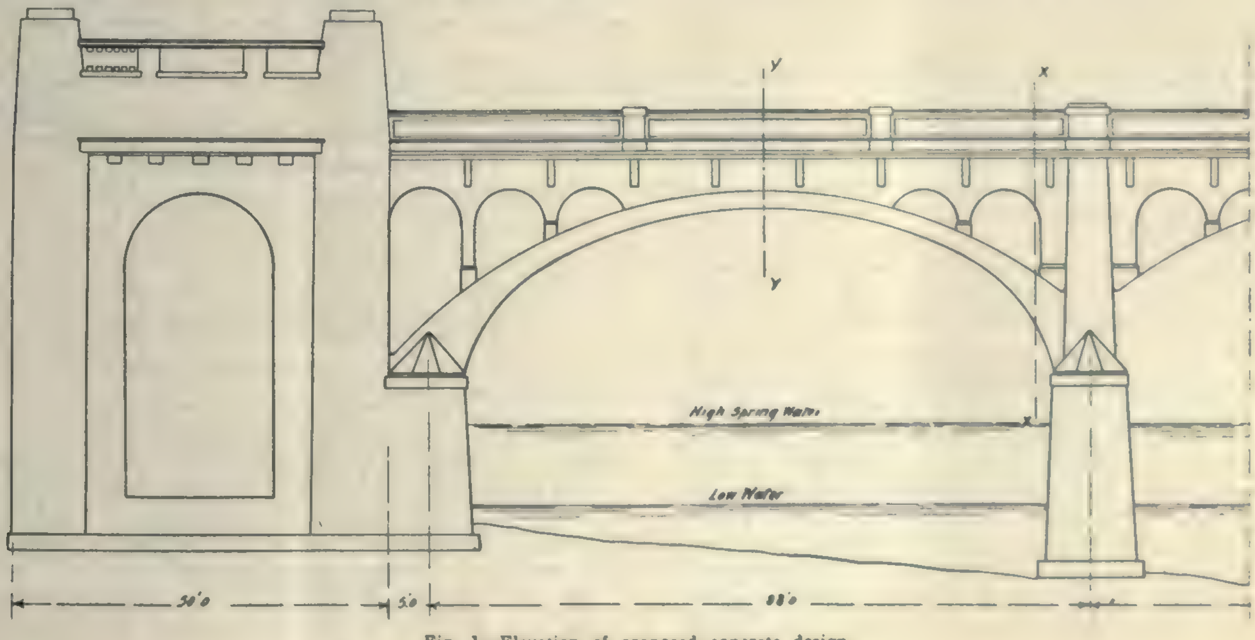


Fig. 1—Elevation of proposed concrete design

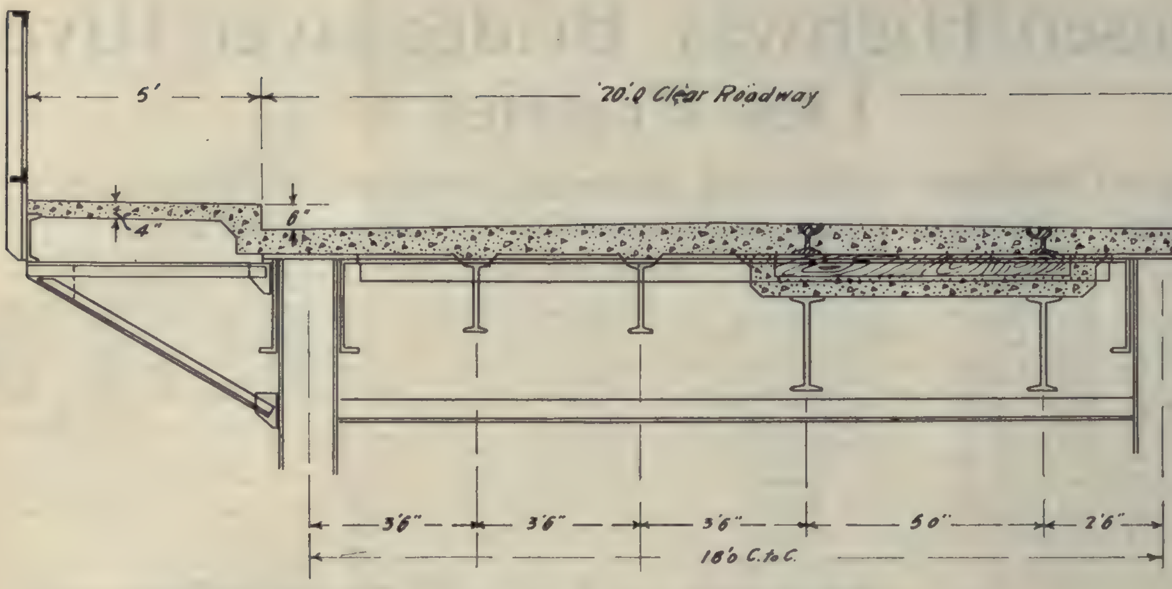


Fig. 3—Cross section, Mr. James Laurin's steel design

Plan and Cost of Steel Bridge

Among the several designs for steel bridges is one prepared by Mr. James Laurin, Civil Engineer of Montreal, a cross section of which is shown in Fig. 3. According to that design the cost of the work would be considerably less than the concrete structure, being narrower—20 foot roadway instead of 40—and sidewalk on one side only. But this second project, while appearing to be more economical for the present, would, it has been suggested, soon become insufficient to take care of the constantly increasing motor traffic through the improved provincial or public highways of which the proposed bridge willl be a connecting link.

The second design consists of a steel structure carried by 11 piers and abutments and provided with a 20 foot concrete roadway and a 5 foot sidewalk. The estimated cost is as follows:

Concrete in piers and abutments		$68,060.00
Cofferdams:		
1 in 4 feet of water	$1,400.00	
2 in 6 feet of water	3,800.00	
4 in 10 feet of water	11,600.00	
1 in 13 feet of water	2,460.00	
1 in 18 feet of water	5,215.00	24,475.00
Bridge floor (complete)		43,087.00
Approaches		80,250.00
Steelwork		130,680.00
		$346,552.00*

*This estimate is exclusive of rails ties and lighting.

Other designs for steelwork are also under consideration. Fig. 4 shows a cross section of a 32 foot roadway bridge provided with double railway tracks and sidewalks on both sides, provision being also made for a 6 in. concrete floor and a 4 in. wood block paving. Prices for steel in this case are based on 45 ton electric car loads. Two different estimates are submitted in this case by the Dominion Bridge Co. for the steel, and, with additional estimates, by Mr. J. Laurin. One design is for a 12 span structure, and the other with 9 spans which includes a 500 foot cantilever span over the river channel. The estimated cost of the first design for a 32 foot roadway is as follows: (1 span 80 ft.; 4 spans 153 ft.; 7 spans 100 ft.)

Concrete in piers and abutments	10,000 cu. yds.	@	$7.50	$75,000.00
Forms	60,000 sq. yds.	@	0.25	15,000.00
Concrete in floor	900 cu. yds.	@	10.00	9,000.00
Paving	5,300 sq. yds.	@	4.00	21,200.00
Sidewalks (concrete)	1,000 cu. yds.	@	10.00	10,000.00
Sidewalk finishing	2,000 sq. yds.	@	1.00	2,000.00
Reinforcing				20,000.00
Cofferdams				54,000.00
Steelwork				175,000.00
Approaches				80,000.00
				$461,200.00

The following is an estimated cost of the work with the long cantilever span: (1 span 75 ft.; 1 span 500 ft.; 7 spans 125 ft.)

Concrete in piers and abutments	9,000 cu. yds.	@	$7.50	$67,500.00
Forms	45,000 sq. yds.	@	0.25	11,250.00
Concrete in floor	900 cu. yds.	@	10.00	9,000.00
Paving	5,300 sq. yds.	@	4.00	21,200.00
Sidewalks (concrete)	1,000 cu. yds.	@	10.00	10,000.00
Sidewalk finishing	2,000 sq. yds.	@	1.00	2,000.00
Reinforcing				20,000.00
Cofferdams				50,000.00
Steel work				138,000.00
Approaches				80,000.00
				$408,950.00

All the above estimates are approximate, and subject to change according to prices of materials and labor. Upon comparison of the estimated cost of the several projects submitted, the cost of the concrete bridge would not be so far above that of the steel structures if figured on the same basis, and keeping in mind the artistic appearance of the concrete design over steel together with the saving in cost of upkeep, the small difference in cost of the former would for these reasons be largely compensated.

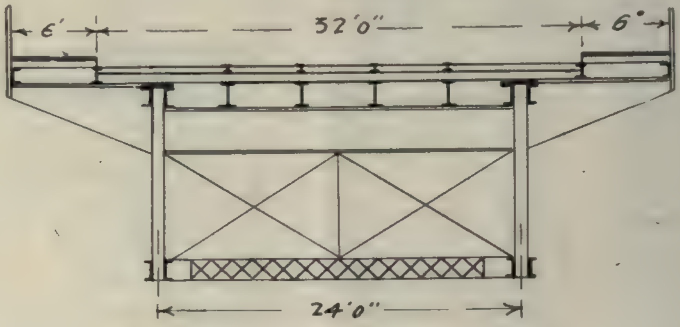


Fig. 4—Cross section of another steel design

The cost of the proposed bridge will be borne equally by the city of Montreal and the provincial government.

Town and Regional Planning in Relation to Sanitation

A Discussion of the Problems of Water Supply and Sewerage with Particular Reference to Toronto and District—Suggestions for the Administration of These Services

By R. O. WYNNE-ROBERTS

In "Journal of the Town Planning Institute"

The term sanitation may be used to cover all works that can be made to contribute to the amenities of the people in connection with public health, including pavements, sidewalks, water supply, refuse removal and disposal, sewerage, sewage disposal or treatment, comfort stations, baths and other public engineering necessaries. The treatment of the subject will here be restricted to the problems of water supply and sewerage and to the Toronto region.

Growth of Toronto

Toronto, in common with other important centres of population, has grown from an insignificant village to a large city surrounded by considerable suburban areas. It is mere speculation to estimate what Toronto will be in say twenty years time in respect to area and population since many circumstances may tend to accelerate or to retard the growth of the city. Yet engineers must make such estimates. The true increase of a city is in geometrical and not arithmetical progression since the number of parents increases in an increasing population. Furthermore, in newer countries immigration has produced profound effects. If we assume an average increase of four per cent in population per annum, Toronto will have 730,000 in 1931 and 1,000,000 in 1941, with an area of probably 45 and 60 square miles respectively.

Surburban Growth

While the expansion of the city of Toronto in population area and wealth has doubtless exceeded the most sanguine expectations of thoughtful men it must be remembered that the outskirts also are growing apace. Within the five miles radius of the city limits there are the towns of Leaside, Weston, Mimico and New Toronto and the townships of Scarboro, York and Etobicoke with an aggregate population of nearly 80,000 persons. The average annual increase in York township during the last six years has been about 12 per cent. What will be the population in ten and twenty years time?

Planning for Water Supply and Sewerage

The planning of our highways, streets, boulevards and parks for future growth would not have been difficult because there would not have been any serious expenditures involved as the plans would have been simply elements of subdivisions. But in the planning of water works and sewerage the case is different. These are expensive undertakings. The centre of gravity of the population in Toronto remained somewhat stationary until 1883 and the prospective spreading of the people was then not so evident as it is now. Great judgment and confidence were needed to anticipate the growth in population and expansion of area.

Annexations

The limits of the city have assumed great elasticity during the past 40 years by frequent annexations of adjoining territories. These annexations, however, tended to expensive outlays because the new areas had to have watermains and sewers as well as other improvements and utilities. One result usually experienced when annexations are made is the costly revision of the existing public works unless by city or regional planning water and sewerage works are arranged and co-ordinated. While it would appear logical for the eight municipal authorities already named to attend to their own local requirements the principle of organizing and administering public utilities on behalf of a combination of municipalities has been fairly well established in this and other countries and with satisfactory results. It has been recognized that service which is a common need should be organized by one body.

A Regional Area

Suppose a combined district were defined approximately as follows: Starting at the lake and following the west side of Etobicoke creek as far north as the C.P.R., thence east along the railway to and north along Kipling road to Brampton road, east along Wilson avenue and Mercer avenue to the east side of east Don river, then generally following the Ridge between the Don river and Highland creek paralleling the G.T.R. south to Scarboro Junction and to the lake, this area, including the city, would measure about 120 square miles. It can of course be much reduced although as a question of policy it should be given every consideration. Now it would seem that one transportation commission would amply suffice to organize efficient electric transportation in this area. Our trunk roads in such area could be easily maintained by one authority whereas there are now ten. Light and power could be purchased and distributed in the same area by one authority at less cost than is possible by the present nine. Water supply and sewerage are now in the hands of each municipality and since we are discussing these utilities the question may be reasonably asked, what is within the range of practical politics in these matters?

Town and Regional Planning

Town and regional planning mean organizing at present for the future welfare of the people. Toronto in some measure recognizes this important elementary principle by undertaking great harbor and foreshore improvements; by advocating extensive transportation schemes; by building splendid university, college and school institutions; by planning parks, boulevards and playgrounds; by controlling subdivisions outside the city limits; by organizing hydro-electric systems and by other methods—all of which contribute to the amenities of the people and to the building up of a great and prosperous city. Some day Greater Toronto will doubtless stretch along the lake front from Scarboro bluffs to Port Credit, a distance of about 25 miles. Millions of dollars are being spent on improvements of the water front extending over about 12 miles, and it is safe to predict that the public will support the preservation of the other 13 miles. A lake front promenade, measuring say 25 miles, would constitute a magnificent attraction to the locality.

Unified Administration

But the question is whether such a desirable consummation can be established by our present several organized civic administrations. The lake is our logical source of water supply. The quantity is unlimited. The quality is capable of being maintained at a high standard provided the discharge of sewage effluents at several outfalls is possible with due regard to its efficient dilution, diffusion and oxidation. Winds and currents often tend to create undesirable conditions unless a careful study is made of these phenomena. Whilst we may survive without certain utilities we cannot without water. It is the primal requisite of an organized communal life. In view of what has already been stated and implied, it would seem rational that one authority instead of several should furnish water to the residents in the city and the outskirts. One authority could maintain a better service than can several, because it could afford to employ higher qualified officials, better supervision, and have a diversified consumption and probably supply at a cheaper rate. Diversified consumption has an important influence on the required capacity of water works equipment, especially for domestic and fire purposes. In smaller installations as much as 70 to 80 per cent. of the capacity of pumps and mains is needed to provide fire protection, whereas in larger cities it may be less than 10 per cent.

Engineering Features of Regional Planning

The engineering features of one large water works system for Greater Toronto do not involve any extraordinary difficulties. The nucleus of such a system is already in operation and a duplicate intake, with pumps, filters and trunk mains, is described in Mr. R. C. Harris's report of 1913, in which he discusses a scheme off Victoria Park. The cost of the duplication is estimated at about $16,000,000.

The demands on the city treasury are great and growing. The taxes are mounting up and it is reasonable to surmise that the city council has a problem to solve in respect of what is most urgently needed and what is within the financial resources of the municipality. If one Metropolitan water board were established with the resources of the adjoining districts placed at its disposal, the financial problem would no doubt be easier to solve. The supply of cheap and pure water to a large area would constitute a remarkable incentive to building operations which are so urgently needed.

Regional Control in Other Countries

There are arguments in favor of the city supplying water in bulk to the neighboring municipalities. There are also arguments to advance in favor of a separate board or commission. If the city should undertake the burden the neighboring municipalities would in some measure be relieved of a considerable financial responsibility. The tendencv to multiply schemes instead of concentrating is not ideal. It is manifest that regional planning in this locality involves one scheme. This principle is not new and it may be profitable to give a few examples.

The Metropolitan Water Board of London (England) attends to the wants of about 7,000,000 people in an area of about 559 square miles. The capital expenditure is about $260,000,000 and the daily supply of water about 275,000,000 gallons. This board superseded eleven companies. About 450 authorities have an interest in this undertaking.

We have a prominent example in Canada, namely the Greater Winnipeg Water District, which came into existence in 1913. This district comprises Winnipeg and seven neighboring municipalities. Water is conveyed 85 miles from Shoal lake, through a conduit capable of carrying about 100 million gallons daily.

It is doubtless unnecessary to multiply examples.

Sewage Disposal

With regard to sewerage and sewage disposal, it may be stated that the geographical position and topographical features of this locality are such that the logical outfall for sewage effluent and storm water is in the bay. A contour map of this district will show that the natural slope of the land within a radius of five miles of the city limits is towards Toronto, except on the west of Humber river. Pumping, of course, could be resorted to but the cost of operation would thereby be increased and it is therefore desirable to avoid pumping where possible, unless there are special reasons for so doing.

Since sewers are ordinarily operated by gravitation the outfalls in this locality have to be located near or in the city limits, and as the district becomes more densely populated the problem of maintaining a satisfactory standard of sanitation for the city and its environs and of preserving the quality of the water supply will become increasingly important. The need for sewerage in the outskirts of the city is a pressing one. Scarboro could discharge sewage or effluent into the bay, but by doing so, it would be necessary to locate the outfall so as to safeguard its own water supply on the one hand and the city's contemplated new source on the other. The township of York has no direct outlet to the lake except at Swansea. The Don river and the Humber river are, of course, available. Leaside discharges its effluent into the Don river and Weston into the Humber. The Mimico and New Toronto effluent is discharged into the bay. The eastern portion of Etobicoke will some day discharge sewage effluent into the Humber river and the western portion together with the township of Toronto and the village of Port Credit will discharge into the lake. The construction of several independent sewerage schemes and sewage treatmen plants by several different authorities would seem to be inadvisable, having regard to the future expansion of the city and would be distinctly opposed to modern city and regional planning.

Regional Commission

It would not be reasonable to expect the city of Toronto to provide sewer accommodation for the many neighboring municipalities. Neither would it be fair that the quality of the city's water supply should in any way be jeopardized now or in the future by a number of sewage works and storm water outlets discharging into the bay. The principles of city and regional planning would involve an intensive study of the whole question to ascertain what could best be done to provide sewerage facilities for the combined areas under review, and so far as it can now be seen the future efficient administration of the district in respect to sanitation will depend upon how such facilities are now organized. It may, however, be pointed out that the solution of similar problems has been found elsewhere through the agency of a representative board or commission. Indeed, it would appear logical that both water and sewerage in this district should be organized and supervised by one board.

The Essex Border Utilities Commission, with twelve members, was created in 1916 by a special act formulated by Ford City, Windsor, Walkerville, Sandwich, Ojibway, etc., to carry out joint trunk sewers, disposal works and water mains and to charge the cost against each municipality, in proportion to the benefit received.

The Vancouver and District Joint Sewerage and Drainage Board was created to attend to the sewerage of Vancouver, Point Grey, Burnaby, etc. The area of the district under the administration of this board is about 80 square miles and the population is about 250,000.

Ways and Means

The questions referred to in this paper are mainly those of what principles might be adopted to serve best the interests of this locality, having regard to the prospective extension of areas and increase of population; whether the present methods are the most appropriate or whether a public body representative of all municipalities within a defined area would better suit the local conditions. If it is considered that a board or commission would be better adapted to our future development, then there are many matters which will require most careful thought and consideration in connection with the organization of a board or commission such as number of members; duration of office; manner of election or appointment; whether independent of the municipalities in its actions; nature of the powers to be granted; method of assessment of the cost of construction and of maintenance; if existing works should be taken over and how they should be evaluated; whether water should be supplied in bulk to the municipalities or the board or commission should take entire charge; whether sewerage service should be assessed according to area, populatton, volume, valuation, and many other important matters.

City and Suburbs are One Community

The interdependence of one municipality on the others must be recognized. We really constitute one large community. The present boundaries are entirely political and arbitrary. A large proportion of those living outside the city limits work within and spend most of their earnings in the city. When transportation is extended to the outskirts the tendency to live in the suburbs will increase. This is the natural desire of most citizens and no artifice is capable of stemming the tide. Indeed health authorities usually advocate the desirability of living in the country for the benefit of the rising generation. We must also recognize that insanitation in the outskirts is a menace to the city dweller, especially where movements of the people in and out are pronounced. Disease is not usually revealed until after much danger of contagion or infection has been caused .

Housing and Town Planning

Moreover, Greater Toronto's future depends largely upon its attractiveness for new industries and the expansion of the old ones. One attraction is a sufficient supply of contented labor. A generous and permanent pay roll is an asset highly desirable to encourage but comfortable and sanitary homes, with facilities to reach them, constitute a remarkable incentive to local industrial and civic development.

Control of Subdivisions

A most important feature of town planning in connection with public utilities is the subdivision of land. In the past, subdivisions have often been made without regard to public usefulness. Streets were sometimes planned where they could not be constructed. Through connections were often neglected. No provision was made in some valleys for sewers in the streets. Cemeteries were laid out without cross streets. The repetition of these disabilities will probably be avoided but this is not sure. It would certainly be an advantage to have contours submitted with the plans of proposed subdivisions. Otherwise it is not clear how a recurrence of these defects can be obviated. The contours should not be confined to the subdivision only, but to some distance outside the limits of the area.

Compressed Air Being Used in Hamilton Sewer Work

The fourth section of the storm overflow sewer, which has just been commenced at Hamilton, will involve the use of compressed air in the six-foot tunnels being bored under the main streets of the city, to prevent the caving in of the surface.

The first shaft has been sunk at the corner of Cannon and James streets, and tunnels six feet in diameter are being bored from this point in both directions along Cannon street. In some places there are fifteen and sixteen feet of loose sand and water above the level where the tunnel must be bored, and it is here the greatest trouble will be experienced. "Pockets" where the strata of the soil has been broken, and cave-ins may be encountered, and for this reason the extra precautions are necessary.

High Pressure

The workmen in the sewer will carry on under "high pressure." The tunnel will be pumped full of air by a compressing machine, the end being sealed by a system of steel doors arranged so as to form a "lock." A pressure of about ten pounds per square inch in the sewer is expected to be sufficient to prevent the earth from sliding in.

Material which is excavated will be carried along the tunnel on cars, will pass through the "lock" chamber and be raised to the street level at Cannon and James Streets by an elevator. Patent shovels, driven by compressed air, are being used to loosen the hardened earth. A second shaft will likely be constructed at Cannon and Macnab Streets. The sewer will extend from the intersection of John and Robert streets to King and Macnab streets.

Although dozens of men will be toiling far below the surface of the earth, under the city's busiest streets, traffic will not be interrupted.

Sewage Treatment by Activated Sludge Plants at Houston, Texas

General Review of Operations at the World's Largest Unit of this Type—Operating Curves and Costs for 1920 and 1921—The Solution of the Dewatering Problem in Sight

(Continued from last week's issue)

The sludge conditioning tests to be described later were preceded in October, 1917, by tests with soda ash, sulphuric acid and heat, "along the lines of the so-called flotation process." Sludge from the re-aeration channel was settled one hour in 50-gal. barrels, the supernatant liquid siphoned off, the settled sludge heated to the desired temperature in galvanized-iron tubs over an open fire, and soda ash added and stirred to effect a complete solution. The sludge was then transferred to a barrel fitted with a valve at the bottom, the acid added with stirring and the contents allowed to separate for various lengths of time.

In this process (1) the acidification of the soda ash (sodium carbonate) frees large volumes of carbon dioxide which are entrained in the sludge and reduce its specific gravity; (2) the excess of acid over that required to neutralize the soda ash produces a chemical and physical effect upon the sludge. The soda ash used contained 58 per cent of sodium carbonate and the sulphuric acid had a specific gravity of 66 deg. Be.

The tests showed that the best results were obtained with 105 lb. soda ash and 268 lb. sulphuric acid per ton of dry sludge at a temperature of not less than 45 deg. (113 deg. F.). At and above this temperature the acid changed "the color of the sludge from an olive to a light brown, apparently causing it to floc in large aggregates," while the "water separated more quickly than from the untreated sludge."

Acidulation increased the percentage of ether-soluble fats from 12.91 to 14.19 and of nitrogen from 6.59 to 6.82. "The fats obtained were liquid and dark brown, in appearance like crude petroleum or heavy lubricating oil," so poor a product as to make fat recovery by this method not feasible. As to this dehydration process as a whole it was concluded that it "would not be successful, but may have some merit as a conditioner before some other final method." With chemicals in the amounts stated just above, and at a price of $3.60 per 100 lb. for soda ash and $22 per ton for sulphuric acid, the soda ash-sulphuric acid-heat method of sludge treatment would cost $6.70 per ton of dried sludge, with no allowance for heat, labor and capital charges.

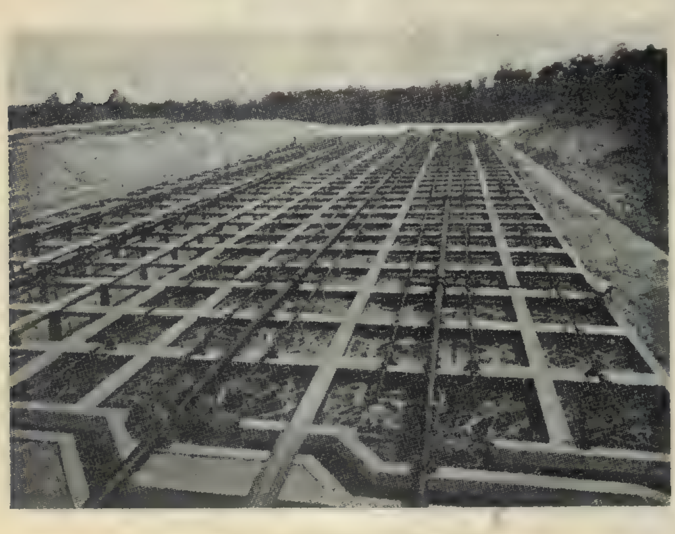
Sludge Dewatering Presses and Driers

Mr. Fugate's description of the plant installed at the north-side or larger works to produce a commercially marketable sludge, the difficulties met and apparently not yet wholly overcome in operation, and the tests on sludge conditioning with (1) sulphuric acid and (2) sulphur dioxide gas and steam is given in full below, and is supplemented by an important statement written by Mr. Fugate on July 8, all as follows:

Early in 1918, a contract was entered into with the Simplex Ejector Co. of Chicago to furnish rams, presses and compressors, and with the Buckeye Dryer Co., Columbus, Ohio, to furnish a rotary dryer, conveyors and elevators, the object of this equipment being to dehydrate the sludge to a moisture content of not over 10 per cent, the resulting material to be used as a nitrogenous base for fertilizer. Due to the unsettled conditions brought about by the war and the period immediately following its close, the entire equipment was not furnished until in December, 1920.

First Stage: Further Sedimentation of Sludge

In this process of dehydrating the sludge, the first stage is to pump the sludge from the re-aerating channel to three 50,000-gal. cypress sedimentation tanks supported by a concrete platform about 16 ft. above the surface of the ground, the maximum head against which the pump works being 50 ft. This pump is a



Aerating Tanks with Air-Supply Piping

Sludge Settling Tanks with Sludge Air-Lift horizontal, split case, bronze impeller volute pump, 500 gal. per minute capacity, direct-connected with flexible coupling to a 10-h.p. General Electric 220-volt, 1,200-r.p.m. motor, set on an extended base.

Considerable trouble has been experienced with the stoppage of this pump by small sticks, matches and fibrous materials, but this has been partly overcome by inserting cutting blades in the casing around which the impellers revolve.

The sludge as it comes from the re-aeration channel contains 99.6 per cent moisture. This is reduced by sedimentation in the cypress tanks to 98 to 99 per cent, depending upon the condition of the sludge and time settled. The tanks are supplied with a pipe grid aerator, so that sludge can be aerated during the pressing time, and also with piping for drawing off the supernatant liquid.

Second Stage: Filter Pressing

In the second stage, the settled sludge flows by gravity to two 500-gal. Simplex rams, or ejectors, where a varying pressure passes the sludge to the filter press. A maximum pressure of 140 lb. has been used, but apparently there is but little advantage gained by using a pressure of over 110 lb. There are two Simplex filter presses, each having 120 33x33-in. center-feed plates, designed for cake 1 in thick. The solids are retained upon the filter cloths, while the filtrate is returned to the aeration tanks. The air pressure for operating the press is furnished by two Gardner horizontal two-stage 8x4x6-in. compressors, maximum pressure 250 lb., speed 300 r.p.m., belt-connected to a 20-h.p. slip ring, 220-volt, 3-phase, 60-cycle Ideal motor, speed 1,140 r.p.m. After pressing the cake is dumped upon an inclined platform and raked into a storage bin fitted with twin-screw conveyors; by these conveyors it is delivered to the feed end of the dryer where the third stage of dehydration takes place.

TABLE IV. PRESSING RESULTS AT THE HOUSTON ACTIVATED SLUDGE PLANT WITH UNCONDITIONED AND WITH CONDITIONED SLUDGE

		Conditioned With	
	Unconditioned	Sulphuric Acid*	Sulphur Dioxide Gas and Steam†
Moisture of sludge, %	98.48	98.70	98.88
Moisture of cake, %	87.37	82.64	85.58
Volume of sludge required to press, gal.	5,850	10,400	11,900
Cloths broken per pressing, no	14	10	28
Av. maximum pressure, lb.	106	110	99
Av. pressing time, hr. and min.	4 42	3–20	3–30
Av. quantity of cake per press, lb	3,280	3,390	3,108
Cake produced of volume of press, %	72.2	75.4	70.7
Quantity of dried sludge per pressing, lb.	335	392	448
Ammonia in dried sludge, %	3.6	4.6	4.6
Sludge lost during drying, %	19.5	33.0	2.2‡
Ratio of evaporation, water to oil	9	6.2	5.8
Evaporation per hour, lb.	1,250	1,025	850
Volumetric efficiency of entire process, %**	58.7	50.2	69.9

* Using 0.01% of acid.

† Using 102 lb. of sulphur and 925 lb. of fuel oil per pressing.

‡ Mr. Fugate states by letter that the number of runs made with sulphur dioxide gas and steam was relatively low—*Editor*.

** Percentage of final dried sludge to the theoretical volume that should be produced per press. "Dried sludge" means the final product of the dewatering process.

Third Stage: Heat Drying, Followed by Pulverizing

The dryer is a Buckeye type A, 5 ft. in diameter and 40 ft. long, known as a direct-indirect heat rotary dryer. The heat is produced in an oil burning furnace which is fitted with a relief stack. The dryer complete has all necessary elevating, conveying and transmission machinery to deliver the dried sludge from the dryer to the pulverizer, storage bins and railroad cars. A conveyor is also installed to pass cake that is not sufficiently dried back from the discharge to the feed end for redrying. The best results are obtained usually by passing back a small quantity of dried material, mixed with the wet, thus making the cake handle better through the conveyors and dryer. The vapors are exhausted by a No. 60 Garden City fan, speed 430 r.p.m. The vapors pass through a baffled dust chamber fitted with a water spray condensor.

A line shaft, speed 300 r.p.m., driven by a 40-h.p. General Electric, 2,200-volt, 3-phase, 60-cycle motor, drives the fan for the vapor chamber, screens and all elevating and conveying machinery, also the fuel, oil pump. A counter shaft belted to the dryer and a Williams Pulverizer is driven by a 25-h.p., 2,200-volt, 3-phase, 60-cycle, Allis-Chalmers motor.

The construction cost of the dehydrating plant was: Building $22,980; presses, $29,945; dryers, $21,353; tanks, $1,993; motors, $826; railroad spur, $5,689; total, exclusive of land, $82,787.

Operating Problems and Conditioning Experiments

In January, 1921, the plant was put into operation. At once various problems began to arise, and instead of the process being simple it was found to be very complex. With no precedent for a guide, the decision was reached to operate the plant on large-scale experiments with a small crew of operators and not attempt the full operation until the trouble was found and remedied if possible.

Filter Cloth Troubles

The presses as received from the manufacturers were fitted with radial ribs in the cake chamber. Drier cake could be obtained with these ribs, but the wear on the clothes made their use prohibitive. During a number of pressings 50 per cent of the cloths would be ruined for further use, even with first-run cloths. Without the ribs the cloths last better but tear around the edges. This is a mechanical fault of the press that has not been overcome. Most of the pressings have been made with 11-oz. duck, but several materials have been tried. The 11-oz. duck gives the best rate of filtration, but hose cloth lasts longer. A specially imported jute cloth has been tried, also several grades of burlap. The life of these is greater than duck, but the filtration rate is much lower and the sludge adheres in larger quantities, making the cloths more difficult to launder. The cloths are most important in pressing and one of the big items of expense.

Pressing results with unconditioned sludge have varied between wide limits. The lowest moisture content of cake was 85 per cent and time of pressing 3¼ hours. The average of all pressings is shown in the first column of figures in Table IV

The maximum evaporation made in any one run was at the rate of 1,751 lb. of water per hour with a 15.2 ratio of water to oil containing 19,000 B.t.u. The average of the three highest runs was: evaporation, 1,722 lb. per hour; ratio, 12.8.

Sludge Conditioned with Sulphuric Acid

It was found that by adding a small amount of acid to the sludge more water could be removed by sedimentation, pressing time reduced, and a better cake obtained. In the early experiments it was thought that the less water to be filtered the less time would be required for a pressing. However, this was found to be true only within certain limits. Experiments to determine the amount of acid required for the minimum moisture with one to three hours sedi-

TABLE V. COMPARATIVE COST OF DEHYDRATING ACTIVATED-SLUDGE FROM RE-AERATION TANKS—(1) RAW; (2) CONDITIONED WITH SULPHURIC ACID; (3) CONDITIONED WITH SULPHUR DIOXIDE GAS AND STEAM

			Sulphuric Acid Gas				Sulphur Dioxide Gas and Steam			
	Raw Sludge—422 Tons per Year		706 Tons Sludge per Year		With Evaporation Ratio of 12 and Rate of 1,535 Lb. per Hr.*		810 Tons Sludge per Year†		600 Tons Sludge per Year‡	
	Pressing	Drying	Pressing	Drying	Pressing	Drying	Pressing	Drying	Pressing	Drying
Superintendence	$4.45	$4.45	$2.70	$2.70	$1.50	$1.50	$2.35	$2.35	$3.15	$3.15
Labor	13.55	9.60	8.10	8.90	4.55	5.00	10.20	7.80	11.20	12.95
Power	3.70	1.45	2.30	1.30	1.25	.70	1.95	1.20	1.60	1.50
Filter cloths	8.50	....	5.10	..	2.85	.	4.45	...	6.00	...
Repairing filter cloths	4.20	....	5.10	.	2.85	.	5.30	...	2.60	....
Laundering filter cloths	2.40	...	1.45	...	.80	.	1.25	...	Included in labor item above	
Sulphuric acid	...	...	8.50		4.70		...	..	.	..
Sulphur	....	....	....	...		....	4.60	....	4.60	....
Fuel oil	....	9.20	...	11.00	...	5.10	11.60	10.05	11.60	10.15
Miscellaneous	1.20	1.20	.85	.85	.40	40	.60	.60	.85	.85
Totals	$38.00	$25.90	$34.10	$24.75	$18.90	$12.70	$42.30	$22.00	$41.60	$28.60
Total cost per ton	$63.90		$58.85		$31.60		$64.30		$70.20	
Probable wholesale value	12.60		16.80		16.80		16.80		16.80	
Net cost	51.30		42.05		14.80		47.50		53.40	
Net cost, retail value	$38.90		$33.85		$6.60		$39.30		$45.20	

* Individual runs produced results that warrant the introduction of cost figures on this basis. † Assuming dryer can be forced to 1,135 lb. evaporation per hour

‡ Assuming 850 lb. evaporated per hour.

All the cost figures, with the exception to be noted are based on the following rates paid in 1921 for salaries, wages and power at the pumping station and disposal plants: Operators, $145 to $160 per month; laborers, $3.75 to $4 per 8-hr. day (some of the labor estimates in the table are based on a rate of 35c. per hour); power, 0.6c. per kilowatt-hour

mentation showed that with 0.01, 0.02, 0.03 and 0.04 of acid the corresponding moistures were 98.71, 97, 96, 98.43 and 98.72.

In practice the sludge was settled in the 50,000-gal. tanks and after drawing off the supernatant liquid the acid was added, thoroughly agitated, and pressing begun immediately. The average results obtained are shown in the second column of figures in Table IV. The moisture could not be reduced in the large tanks as low as in the laboratory, due to the difficulty of removing the supernatant liquid as efficiently as in the laboratory.

This shows that considerable advantage is gained in pressing by using acid, but is partly lost in drying. It has been observed that acidified sludge when introduced into the dryer has a marked tendency to roll up in balls of different sizes, ranging from that of a small pea to several inches in diameter. As the drying advances the sludge reacts differently according to its character. It may break into flaky particles or form small balls with a hard, smooth surface. The latter condition is found to prevail with a sludge of a relatively large fat content, say between 9 and 12½ per cent. The untreated sludge after drying contains about 3.5 per cent of fats.

The reason for better dehydrating qualities of raw cake, as compared with acidified sludge cake, lies probably in the fact that the addition of sulphuric acid raises the fat content of the cake, and that the coagulated colloidal matter gives up its moisture less readily; also that the presence of any free sulphuric acid with its low volatility would retard the drying process.

Advantages and Disadvantages of Acid Conditioning

The advantages of using acid are in the lower moisture content of the cake, less time to press, and the increased nitrogen content; also the cake keeps better and dries with less odor. Odors, however, are not offensive if the cake is dried immediately after pressing.

The disadvantages are the lower evaporation ratio, a greater loss in drying, the drying process more difficult to control, more or less personal danger in handling the acid, the probable deteriorating effect upon the plant, and the increased fat content. About 10 per cent of the dry sludge is collected as dust from the dust room, and this amount seems to be the same with either unconditioned or conditioned sludge.

In the experiments described, the acid was applied to the total quantity of sludge to be pressed. A period of three or four hours would elapse from the beginning of the pressing to the close, during the latter part of which the sludge had a tendency to become alkaline. Equipment is being installed to apply the acid to each charge of sludge just before reaching the press and to use the hydrogen-ion concentration as control. It is believed that much better results may be obtained this way, as the sludge will reach the filter immediately after being acidified, thus doing away with the time element in pressing; also drying immediately after pressing may increase the drying efficiency.

In co-operation with the MacLachlan Reduction Process Co. of New York City, experiments have been made by gassing the sludge with sulphur dioxide mixed with steam immediately before pressing. (See last column of Table IV. for comparative results.)

Advantages and Disadvantages

The disadvantages of this method are: The bad effects of the sulphur fumes upon the operators, cost of oil used for producing the steam, and the low rate and ratio of evaporation. But there seem to be certain advantages and it is expected to continue the experiments with the view of eliminating the undesirable features mentioned. Based on these experiments, a comparison of costs of the different methods has been made showing the probable cost to operate the present plant. (See Table V.)

The following conclusions have been reached as a result of the 1922 dewatering tests:

The experiments with sulphur dioxide gas, which we have carried into 1922, are giving most promising results. The process, which has been developed in co-operation with the MacLachlan Reduction Process Co., consists of gassing the raw sludge without the use of steam, the gas being transmitted from the generator by a positive presser blower, and the gassed sludge passing through a continuous roller press, giving to date a cake of 78 per cent uniform moisture. The operation being continuous, there is no laundering of filter cloths. This method also does away with expensive delays which were experienced with the plate filter press. We are sure that we can produce cake of 78 per cent moisture for about $5 a ton, dry basis, thus reducing the pressing costs from about $40 to $5 a ton.

We now feel that our dewatering plant will be put in continuous full-time operation and the dewatering problem satisfactorily solved.

Exhibits of Interest to Contractors at the Canadian National Exhibition

The contracting and allied industries are again being represented with an excellent array of exhibits at the Canadian National Exhibition, at present under way in Toronto. These exhibits are many and varied and are spread through nearly every commercial building and to every corner of the grounds. many of these are outstanding, but all are coming in for their share of attention from the thousands of people who visit the Fair every day.

Machinery Hall

The Watkins Wire & Rope Products Co. Ltd., of Eastwood, Notts, England, represented in Eastern Canada by Macaulay Pope, of Toronto, are showing their full line of wire, wire ropes and cables in their booth in Machinery Hall.

* * *

The Rawlplug Company of Canada are also displaying their product in this building and are showing many interesting applications of this new article, the rawlplug, in various materials. This booth is a very popular one, its many visitors being interested in this new method of neatly and securely fastening screws in such materials as plaster, bricks, etc.

* * *

The Elliot Machinery Company of Belleville, Ont., are again located in this building, demonstrating their well known line of woodworking machinery. As usual they are featuring the Elliot Woodworker, a machine comprising saw, planer, etc.

* * *

Here, too, is located again the exhibit of the Canadian Link Belt Company. This company feature their show with a working example of their silent chain drive. Samples of the various sized links which compose their extensive line of chains are also on display, as well as many interesting photographs of their various large contracting units at work.

* * *

The exhibit of the Koehring Company of Canada, Ltd., also in this building, consists of the showing of their light and heavy duty concrete mixing machinery. Many representatives of the company are on hand to explain the working of these well known units to the many interested visitors.

* * *

Grounds

The Sawyer System of Canada, manufacturers of the well known type of wall and ceiling construction of this name, have erected a small one-room square structure of this material in a prominent part of the grounds, which constitutes their exhibit.

* * *

The Granite Concrete Block Company, of Weston Road, Toronto, have erected a small section of wall, which shows to the best possible advantage the application of their product, in front of their large tent. Many interesting photographs are also being shown of this material in construction work throughout Canada.

* * *

The Metallic Roofing Company, of Toronto, are showing two small garage buildings at their large exhibit on the grounds, which have been constructed of the company's products. Eavetroughs, metal ventilators and various other metal products manufactured by the company are also on display.

* * *

The Toronto Asphalt Roofing Company have a very attractive showing of colored roofing materials at their tent on the grounds.

* * *

The Canadian Concrete Block Company also have a tent on the grounds and are showing a small uncompleted section of wall constructed of the company's product.

* * *

The handsome bungalow of the Bishopric Company of Canada, has been overhauled this year and the exterior walls, which were formerly constructed of the company's rough colored stucco are being covered with a smooth stucco finish. McDermott Bros., representing the Canadian Roofing Company are located in this bungalow also and are showing the latter company's well known line of "Caromco" roofing materials, including the new tapered shingle, which is used in the roofing of the bungalow. This is a very attractive exhibit.

* * *

The Abestos Manufacturing Company, of Lachine, P.Q., are again located in their pretty little bungalow. In addition to the products displayed in the construction of the building itself, the company are showing inside their many products which include asbestos pipe and boiler coverings, "Linasbestos" fireproof wallboard, etc.

* * *

The Brantford Roofing Company of Brantford, and Messrs. Bird & Son, of Hamilton, manufacturers of the "Neponset" line of building papers, roofing materials, wallboard, etc., also have their own permanent bungalows, showing their respective products in actual application. These are both quite roomy buildings and are tastefully finished within and without.

* * *

The pretty little white bungalow of the Ontario Gypsum Company is as popular as ever this year again. The walls of this building, exterior and interior, are constructed of gypsum products and samples of these, as well as a quantity of interesting literature are being handed to the many visitors.

* * *

The exhibit of the Canada Creosoting Company is located in a tent on the grounds, the floor of which is constructed of the company's creosoted wood blocks. This product is used estensively in factory floor construction. Several samples of creosoted wood piling are also on display. Mr. L. I. Parmenter is in charge of the exhibit.

* * *

Mussens Limited are showing many pieces of road and contracting machinery at their large exhibit on the grounds, these including a John Inglis road roller, a fresno, road maintainer, wheel scraper, etc. Mr. DeWind is in charge of this display.

* * *

The extensive line of contracting machinery shown by Wettlaufer Bros., of Toronto, occupied considerable space on the grounds. The display included crushers, hoists pavers, loaders, brick and block machines, etc.

* * *

The exhibit of Messrs. Balmer & Blakeley, of Toronto, manufacturers and designers of ornamental plaster and cement work for interior and exterior relief work, is situated in the Electric Building and comprises many beautiful examples of this art.

* * *

Industrial Building

The Cookville Shale Brick Company are located in a handsome booth in the Industrial Building, the walls of which are built up with the company's product. Mr. A. W. Cote is in charge of the exhibit.

* * *

The Higgins Manufacturing Company are showing their products, metal window screens and weatherstrip, in their booth in the Industrial Building, window sections being used for this purpose.

The International Nickel Company also have their exhibit in this building and are featuring their Monel Metal. An extensive line of household and other articles manufactured from the company's product are attractively shown.

* * *

The product of the Chamberlain Metal Weather Strip Company is shown in actual application at their booth in the Industrial Building, a window section being erected in the centre of the booth, equipped with metal weatherstrip.

* * *

The Consolidated Plate Glass Company's booth in the Industrial Building has a full size Zouri metal store front complete with plate glass windows. Their various products in glass are shown within. This is one of the most imposing and attractive displays in the building.

* * *

The display of doors at the exhibit of the Pannill Door Company, also in the Industrial Building, is a very attractive one and includes a wide range of doors in many patterns and of various woods, several being finished in white enamel.

* * *

The Buyers Door & Manufacturing Co., of Canada are again located in the Industrial Building and have a fine display of doors, interior fittings, stair materials, etc.

(To be continued in next week's issue)

Rebuilding Granite Block Pavements

Specifications for Cutting and Re-Using Blocks and Cost Figures—Description of the Heater Method of Re-Surfacing with Asphalt

By JACOB SCHMITT

Paper read before City Paving Conference, Philadelphia

In repaving a granite paved street the old material, where discarded, has but little salvage value to the community, because of the uncertain market for second-hand paving blocks. Contractors can afford to make but little allowance for such blocks and in consequence the community bears in full the value of the new blocks required. Why, therefore, should not the market for the old blocks be made on the job?

The blocks on many streets requiring reconstruction are of the old type, large size, 10 to 14 in. long, 3½ to 5 in. wide, and 7 to 8 in. deep. The size in use today is 8 to 12 in. long, 3½ to 4½ in. wide, and 5 in. deep. The cubical contents of the old type block is practically double that of the newer type, so that two blocks can be produced from one. This is therefore done by splitting the old block through its center and redressing the resultant two blocks. The heart of the old block becomes the head of the new. In many cases it is not possible to obtain two blocks from one, owing to defects in the old stone, but the percentage of blocks suitable to produce two recut blocks is generally sufficient to overcome the loss in recutting and rejects. Experience has proven that the gain and loss practically balance. As a rule, there is a small surplus of blocks and in only a few cases has there been a deficiency. The only difference made in the size of block from current specifications (Brooklyn) for improved granite block is that the minimum length of block allowed is 6 in., as against 8 for new blocks, with a minimum width of 3¼ in. as against 3½.

Specifications for Recut Blocks

These blocks are laid to the same specification requirements as for new blocks, with ½ in. maximum joints and 1 in. cushion, and bituminous or grout joint filler. The concrete foundation is built up by a full 3 in., the difference between the old 7½ in. block on 1½ in. cushion and the recut 5 in. block on 1 in. cushion. The following is an extract from specifications for this class of work:

"When the use of blocks recut from old granite blocks is permitted under the contract, such blocks shall comply with the specifications for quality as required for new blocks, and be of the following dimensions: not less than 6 nor more than 10 in. long on top; not less than 3¼ nor more than 4½ in. wide on top, and not less than 4¾ nor more than 5¼ in. deep. The recut block shall be dressed in the manner specified for new blocks; the sides and ends shall be sufficiently smooth to permit of the blocks being laid with joints not exceeding ½ in. in width at the top and for 1 in. downward therefrom, and not exceeding 1 in. at any other part of the joint. The blocks shall be cut so that the face will be approximately rectangular in shape. The top surface of the block shall be cut so that there will be no depression measuring more than ⅜ in. from a straight edge laid in any direction on the top and parallel with the general surface thereof."

Of this type of reconstructed pavement there had been laid in Brooklyn, N. Y., approximately 4,000 sq. yds. in 1919, 11,000 sq. yds. in 1920, 48,000 sq. yds. in 1921, with 62,000 sq. yds. (fall of 1921) now in progress or under contract.

Cost of Recutting Blocks

The recutting of the blocks costs about $30.00 per thousand, against a price on the work for new blocks of $130. This difference is partially counter-balanced by the average size of the blocks, which run about 40 to the square yard, against 28 for new blocks. In September, 1921, bids were taken for both new and recut granite pavements, the new being priced at $5.25 per square yard for pavements only, as against $2.77 for recut blocks.

The results obtained have been entirely satisfactory and the saving in cost substantial. While old pavements may be so worn as to be useless for recutting, the method offers a practical solution of the problem of salvaging granite pavements which are worn but not worn out.

The Borough of Brooklyn, N.Y., with its 11,000,000 sq. yds. of asphalt pavement, has had the difficulty of keeping such pavements in repair to a greater extent than most municipalities. The older pavements were laid without the careful attention to formula now given, with the result that much creeping and pushing of these pavements occurs under modern heavy traffic. Though far from worn out, their surface may be distinctly irregular and wavy. The asphalt may have in it many years of life, but be in such condition as to surface that a general overhauling is necessary. This is accomplished by the heater method of resurfacing.

The surface of the pavement is heated to a temperature such that about ½ in. of its surface is softened and can be scraped off. A layer of new asphalt surface mixture is spread upon the heated surface and rolled and finished in the same manner as surface otherwise laid. If properly applied, this method produces an excellent bond. Many test cuts have indicated perfect adhesion of the new asphalt to the old, and the maintenance costs on resurfaced streets compare favorably with new full depth pavements. The heater used is designed to soften the pavement by hot air blast, the flame not being permitted to impinge on the pavement surface. The new layer is laid to an average thickness of 1 in. In preparation of the work before applying the heater, all excessive waves or hummocks are removed by cutting down to the foundation. The asphalt used is similar in formula to that employed on heavy traffic streets, its composition being as follows:

Passing 8-mesh sieve, retained by 10-mesh sieve	0% to 5%
Passing 8-mesh sieve, retained by 40-mesh sieve	25% to 45%
Passing 40-mesh sieve, retained by 80-mesh sieve	20% to 55%
Passing 80-mesh sieve, retained by 200-mesh sieve	10% to 30%
Passing 200-mesh sieve, ...	13% to 20%

Bitumen, 9.5% to 12.5%.
Penetration of A. C., 35 to 45.

Should the old material be of doubtful stability, the use of the surfacing of stiff mixture serves as a protective coat and minimizes the creeping of the pavement.

This method has been used with success on streets of moderately heavy traffic, but its field lies chiefly in the improvement of pavements subjected to average traffic of residential sections and secondary arteries.

Specifications for Heater Method

The following extracts from specification for such work are submitted:

"The repaving or resurfacing of the asphalt shall be done by process or method of heating and removing the surface of the old pavement by means of a properly constructed surface heater. The essential feature of this heater shall be that no flame comes directly in touch with the surface to be heated or softened. Its general construction shall be such as will admit of heated air being blown upon the surface of the old pavement to be removed, thereby heating and softening it so that all inert, disintegrated, worthless and uneven or irregular surface material can be easily removed by means of hoes, rakes, or other appliances.

"The contractor shall use proper guards to prevent the heat from cracking or injuring the curb, headers, or other structures along the line of the work. He shall prevent heat emitted from the stack from injuring trees or shrubs.

"Where excessive waves or hummocks exist, along headers and around manholes or wear holes, the contractor will be required to remove the old material by cutting to the foundation, where directed by the engineer, and replacing it entirely with new material.

"The surface of the old material must be clean, soft and hot at the time that new material is laid thereon. Should the surface become chilled, hardened, or dirty, it must be reheated and again cleaned before new material is applied.

"After the surface of the old material has been properly prepared, a coating of new material shall be laid thereon to such a thickness as to give when rolled, a layer of new material over the old not less than ¾ of an inch in thickness, and averaging as nearly as possible 1 in. in depth, after rolling."

In the Borough of Brooklyn 50,000 to 100,000 sq. yds. per year of heater resurfacing has been carried out for some years past with entirely satisfactory results.

The price in September, 1921, was $1.09 per cubic foot of wearing surface mixture or $1.58 per square yard. This compared with a price for asphalt only laid on the foundation of $2.25, including removal of the old pavement. In September, 1920, the price was $1.43 per cubic foot or $2.03 per square yard, comparing with a price of $3.65 for specification asphalt. The price of resurfacing, therefore, ranges from 60 to 70 per cent. of new asphalt, exclusive each of foundation.

This method is believed to be the most practical for salvaging the useful part of an old asphalt pavement. The material requiring handling is reduced to a minimum; the work is performed expeditiously and with the least possible inconvenience to residents on the street. Various methods of re-employing old asphalt in the preparation of a new mixture have been tried with varying success. The heater method, however, has been successfully used for years, and while the saving effected is less than in the case of the recutting of granite blocks, it is substantial and is supplemented by the comfort to residents in having a repavement started and finished the same day.

Some Old and New Grading Tools

Recent Developments in Road Maintaining Machinery—and Some New Applications of the Older Types

By N. DeWIND

With the ever increasing demand for road construction and road improvement, manufacturers of grading equipment have been kept busy bringing out new tools, or re-designing their old equipment to suit the needs of the modern contractor in handling material.

Some of the simplest operations in handling earth and gravel can be made a profit or a loss by good or bad judgment in getting the right or wrong tools on the job. A recent instance came under the writer's notice in the case of making a road side ditch in Ontario in connection with about thirty miles of grading. It looked from the nature of the work to be done (a narrow ditch with high sides, with 1 in 1½ slope). that it would be impossible to do the work any other way than by hand—gangs of men with picks and shovels. Nevertheless the contractor for the job had the courage to try some other way and he adopted the ditcher and backsloper illustrated in Fig. 1, with the greatest success, converting what would have been a slow and expensive process into a comparatively easy one. The results with the machine-formed bank on each side of the ditch were uniform and pleasing in every way.

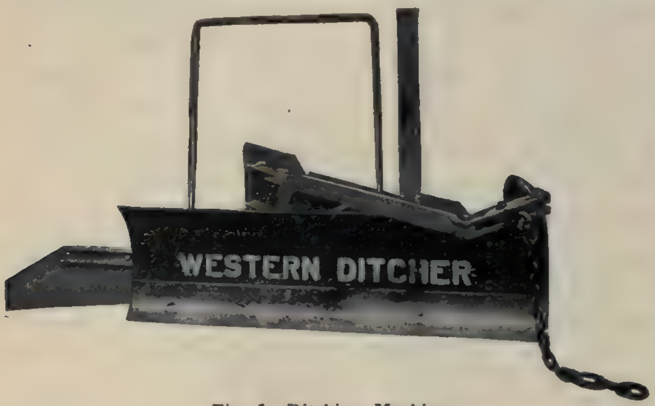


Fig. 1—Ditching Machine

Another recent development is a piece of equipment to overcome the rutting of earth roads. The excessive traffic both by wagon and motors over narrow earth roads has increased the inconvenience and danger from deep ruts, especially on a single track road. The device illustrated in Fig. 2 can be attached to the frame of any four or six horse grader and when the machine is so equipped it can be operated by horses or a small tractor with great advantage on earth roads. The underlying idea of this machine is not to make roads, but to maintain them in proper condition once they are made. This "maintainer" covers from ten to sixteen feet of road on one traverse and if used before or after rain will keep the ruts properly filled and prevent the fine material being washed by rains, or pushed by traffic down to the sides of the road. On the principle that a "stitch in time saves nine," this machine can be used economically during the spring, summer and fall months, and is what may be termed a "Once Over" machine; one traverse of the travelled portion of the road makes a wonderful difference in the filling and ultimate dissapearance of rutting. It has been observed that when even a narrow road is kept free from ruts the traffic distributes better over the width of the road, but as soon as a well defined rut is allowed to appear, wagons and trucks alike will follow the line of least resistance, which means perpetuating the ruts until they become a menace to the user of the road. This road maintainer will cover many miles of road in a day and while it will not clean ditches or build roads, it will maintain the travelled portion at a lower cost than an ordinary grader could possibly do.

In many parts of Eastern Canada and throughout Ontario the Fresno or Buck scraper is completely unknown, yet this is an old and well known piece of equipment with many of the earth handling contractors in the States and amongst the irrigation farmers of Western Canada. It will do three or four times the work of a drag scraper and is good on the short hauls where a wheeled scraper might be considered necessary. When an operator has had a little experience using a Fresno he can do wonderful work, not only in moving the material in large quantities, but can spread it almost as well as a grader blade can do it. Fresnos are made in sizes ranging from five feet wide down to about three feet and can be operated by two or more horses according to the nature of the work. A renewal bit or edge does the cutting and protects the bottom of the Fresno from excessive wear, and the cross bar is adjustable so that any degree of tipping or spreading angle can be secured. A new application of the Fresno has been made in Ontario in the gravel pit where a remarkable amount of work can be done. A recent instance came to the writer's notice in a small gravel pit temporarily operated for road work. An elevator and screen of the portable type has been erected in the pit and a single five foot Fresno with two and sometimes three horses pulled down enough gravel to the elevator boot to keep four motor trucks hauling all day to the road. On stock pile work, for sand and gravel, or in grading work where the grade has first been loosened by a plow the Fresno is a highly economical tool.

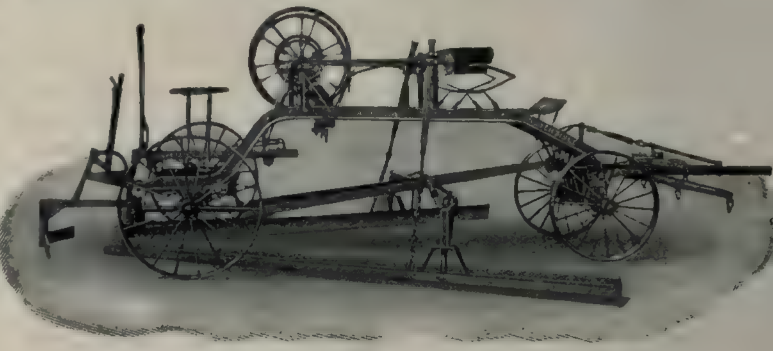


Fig. 2—Road Maintainer

Loading and screening sand and gravel is another important operation which modern concrete work and road building has brought to the front. It has been recognized in hauling material that the greatest losses in time are caused at the beginning and end of the journey, namely, loading and unloading the vehicles. It is not always easy to provide a loading plant that is efficient and yet cheap enough to suit the comparatively small or temporary job. However, a plant of the type shown in Fig. 3 has gone far to remove this difficulty. This consists of a storage bin of twenty to twenty-five tons capacity, mounted on steel axles and wheels having ten or twelve inch tread, a folding elevator, and a revolving screen which can be raised or lowered into the bin and provides a plant which can be set up ready for operation in a few minutes. This plant will handle from 200 to 400 tons of gravel per day and will load a truck or wagon at both sides, thus saving the time lost when two trucks happen to arrive at the loading plant at the same time. With a storage bin of this sort a truck can be loaded in two or three minutes, and where screening is desired the bin is divided into two or three pockets, each pocket having two discharge chutes and a steel lined bottom. The screen and elevator are operated by an 8 h.p. gasoline engine carried under the bin in an enclosed compartment shown in the figure. The plant is self contained and shows considerable saving in the loading of the material as compared to any other method. One of these plants with one or two Fresno scrapers will operate a moderate size sand and gravel pit and the capital investment need not exceed $2,000.00.

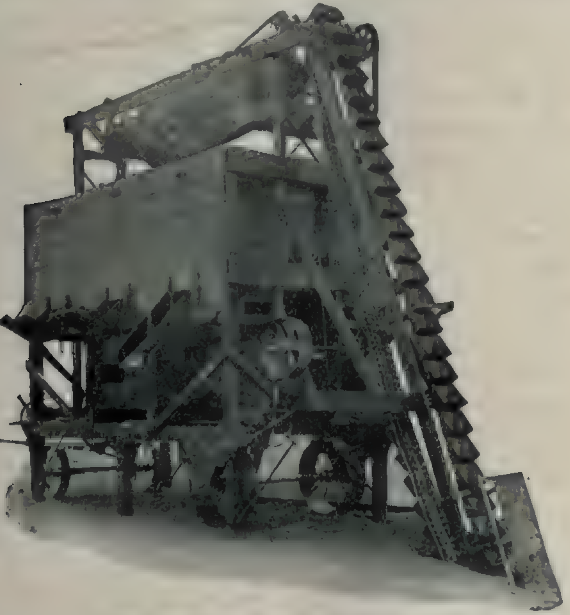


Fig. 3—Gravel, stone and sand loader

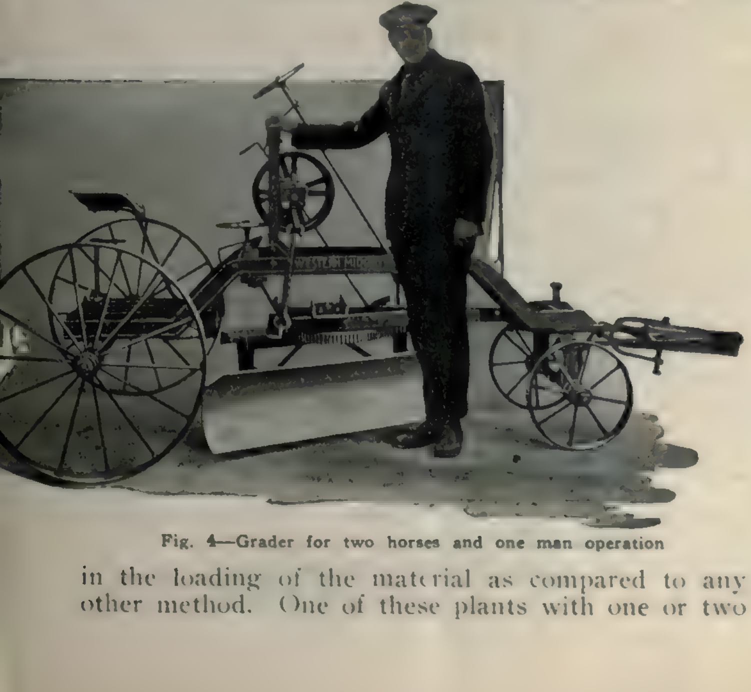


Fig. 4—Grader for two horses and one man operation

Another machine which modern road conditions has forced to the front is the two-horse, one-man grader, Fig. 4. The original idea in this a few years ago was a simplified machine to do patrol work, that is, to scrape the road and fill the ruts. More recent developments have shown that a properly designed tool like the two-horse, one-man grader can do a lot of other work as well. The earlier machines made the mistake in not having the full floating blade adjustments found on the larger graders as they were intended merely to scrape the road surface. It has now been shown that with the high arched frame and a full floating blade, capable of complete reversal and setting at an angle, these two-horse graders can be used for cleaning out ditches and forming road shoulders in a way that the earlier machines never contemplate being used.

Another necessity in a small grader used in this way is to have high wheels. The illustration shows one of these graders equipped with 36 inch rear wheels; these wheels having concaved tires which bite into the road and resist the side pressure of the blade. The extension axel enables the machine to work against the bank like the big grader. In some instances the contractors for macadam roads are using these high wheel graders with great satisfaction for spreading material and forming the road shoulders.

Numerous other old style grading tools are finding new applications in modern highway work, but in an article of this character it would be too lengthy to attempt full descriptions. The elevating grader, however, should be mentioned as one of the machines that has been brought over from railway and ditch digging into the highway field and this tool together with the modern caterpillar tractor, has proved an invaluable machine for cutting down hills, forming ditches, widening the right of way of highways, and work of a similar nature.

Tests of Jointing Materials for Vitrified Clay Pipe

Results Show "Compound" Joints Will Stand 10-lb. Pressure Without Leaking

A valuable final report has just been issued by the College of Industries, Carnegie Institute of Technology, Pittsburgh, describing experiments of Professor S. E. Dibble on the use of bituminous compounds in jointing vitrified clay pipe. Professor Dibble reaches the conclusion that "vitrified clay pipes can be jointed and the joints can stand a pressure of 10 lbs., without showing any leaks, provided a compound is used similar to those mentioned in this report." A number of individual tests were carried out in the laboratory, which are described in the report. Many of these experiments are as valuable for what they teach us to avoid, as others are in teaching us how good joints may be made. The most valuable of these experiments are reproduced below:

(1) Test to show tightness of joints by using cement and sand.—6 in. pipe, four lengths being used, making three joints. One strand of oakum was caulked into the annular space and the joint was made with Portland cement and sand, proportion being one-half and one-half. After setting twenty-four hours a pressure of three pounds was applied and the joints showed no leaks; a pressure of 6 lbs. was then applied and all joints leaked. The reason for the joints leaking was due to the small amount of cement that was applied to the joint.

(2) Test to furnish data when neat cement is used.—8 in. pipe, four lengths making three joints. Neat Portland cement was used in making joints. One strand of oakum was first inserted in the annular space, the neat Portland cement was mixed and the annular space completely filled, cement lapping over onto the hub and extending 2 inches out on the straight pipe. The cement was allowed to set for forty-eight hours, at which time the pipe was completely filled with water and subjected to a hydrostatic test of 4 foot head. No leaks developed with this pressure. 5 lbs. gauge pressure was then applied and a leak developed due to poor workmanship in the bottom of one joint. 5 lbs. pressure was then increased and leaks developed in all the joints both at the top and at the bottom. Unskilled labor prepared the joints.

(3) Test to give data when cement and sand are used.—10 in. pipe and cement was used in this test. The mixture of cement was one-half sand and one-half cement. The annular space was first packed with one strand of oakum and the cement was lapped over on the hub. After allowing to harden for forty-eight hours a pressure of 3 lbs. was applied; the result was that all the joints leaked. It was evident by this result that the cement should have been carried over the hub and extended along the pipe at least two or three inches. The cement should have been applied with a trowel and skilled labor should have made the joints.

(4) Test to furnish data on repairing a leak in compound joint.—4 in. pipe was used and the three joints were made by the use of compound. The annular space in pipe was first caulked with one strand of oakum, then the compound was poured at about 360 degrees F. An asbestos joint runner was used in this test. Before fixing the joint runner it was thoroughly wet and then tamped around the pipe. A test of 5 lbs. pressure was immediately applied. A small leak appeared in the second joint and this was made tight by first relieving the pressure and then melting the compound around the joint near where the leak appeared and then applying more compound which was in a plastic condition. The compound was then pressed against the sides of the hub and pipe, after which the torch was again applied and the surface of this patch was completely melted and allowed to just flow. The test was again applied and all joints were tight at 5 lbs. pressure. These four lengths of pipe were then lifted and supported at each end, leaving the three joints without support. 180 lbs. (weight of one man) was then placed on top of the middle joint and the 5 lbs. pressure again applied after the pipe was out of alignment. All joints were tight.

(5) Test to furnish data on tightness of compound joint after being moved around.—8 in. pipe was used, three lengths making two joints. Compound was used with an asbestos joint runner. This compound was heated until it ran like water. The compound was allowed ten minutes to set and cool, then 5 lbs. pressure was applied, and all joints were perfectly tight. This pipe was moved across the room, carried by two men, and set upon a framework and a test again applied, and all three joints remained tight.

(6) Test to furnish data on tightness of joint when pouring opening was built up.—Four lengths of 6 in. pipe were used making three joints. Compound was used after caulking each joint with one strand of oakum. An asbestos joint runner thoroughly soaked in water was used. It is found necessary in these tests to build up the opening on the top of the pipe where the asbestos joint runner comes together. These openings can be built up sufficiently to allow the compound to perfectly fill the entire annular space, by using ordinary mud or clay that is found on the job. A pressure of 10 lbs. applied to these joints proved all tight, showing no signs of moisture.

(7) Test to supply data on the temperature and speed of pouring.—Three lengths of 10 in. pipe was used with compound as a jointing material. These joints were poured with the pipe in a horizontal position after one strand of oakum had been caulked into each joint. The compound was brought up to a temperature of about 480 degrees F. and poured very slowly. A test of 5 lbs. was immediately applied, and it was found that one joint leaked a trifle. This was due to the slow pouring of the molten compound, which showed that when larger sized pipes are to be jointed with this compound that the jointing material must be very hot and must be poured very rapidly to avoid its cooling and setting before reaching the bottom of the joint. This leak which developed in this test was immediately heated and made tight. The test was again applied and joints were found perfectly tight.

(8) Test to supply data when oakum was loosely packed, also when pipe is placed vertically.—Three lengths of 8 in. pipe, making two joints, were set in a vertical position, the annular space of each joint having one strand of oakum caulked into it to act as a packing and to keep the compound from running into the bore of the pipe. The compound was poured at a temperature of about 330 degrees F. It required two ladles to completely fill the annular space. After the joint had cooled the pipe was carried across the room, laid on the floor and subjected to the 5 lbs. pressure test. The joints were entirely tight and showed no leak at any point. Joint No. 1 on this test had been so arranged with loosely packed oakum so that a leak would develop in case the oakum was not perfectly packed. The result of this was that the heated compound completely surrounded and permeated the oakum which was left loose and made the entire joint tight. A further test of 10 lbs. was applied to this 8 in. pipe and then a 12 lbs. test. Finally a 15 lbs. test was applied and all joints remained tight.

(9) Test to furnish data when glazed and unglazed pipe is used, and pipe placed in vertical position.—Three lengths of 6 in. pipe, two of which were glazed and one unglazed, making three joints, were placed in an upright position. After one strand of oakum had been packed into each joint, compound was poured and the annular space was not quite filled. A space of about 3/8 in. from the top was without compound. This pipe was then placed in a horizontal position, a test of 5 and then 10 and then 15 lbs. was applied, and all joints remained tight.

(10) Test to supply data when oakum is wet, and pipe is wet.—Three joints of 4 in. pipe were placed in a horizontal position and into the annular space one strand of oakum soaked with water was packed. The entire bell and socket were saturated with water by dousing a pail full of water on top of the bell. While everything was wet the asbestos joint runner was placed around the joint and the compound poured while it was very hot. The result, after a 5 lbs test was applied, was that each joint leaked very badly. This was accounted for by the formation of steam as the hot compound struck the water. The water immediately chilled the compound and the steam that was produced prevented contact between the compound and the walls of the pipe and bell.

(11) Test to furnish data on repairing a leak in bottom of pipe, when in a trench.—Three lengths of 10 in. pipe making two joints were placed in a horizontal position and compound poured so as to develop a definite leak for the purpose of testing and finding an exact method for patching where leaks occurred. This pipe was then placed in such a position that it represented the bottom of a ditch; that is, that the working space around the pipe was only two feet. In this position the portion of a joint where a leak developed was placed at the bottom of the ditch. All pressure on the interior of the pipe was relieved and a torch was applied to the underside or to the point where the leak developed. After the compound had started to melt an additional amount of compound was applied when it was at the consistency of soft putty. This added material was well pressed against the pipe and against the hub, the torch then being applied to melt the surface. Seven minutes only were required to make this patch, after which a test of 5 lbs., and then 10 lbs., was applied and the joint was perfectly tight.

(12) Test to determine data when compound is poured with pipe in a vertical position.—Three lengths of 10 in. pipe were used, making two joints, and placed in a vertical position. The annular space was filled with one strand of oakum and this oakum was thoroughly caulked, care being taken to tamp the oakum so that it made a solid packing. Compound was then used as a jointing material. This material when molten flows freely, almost like water. After the joints were poured they were placed in a horizontal position and the test of 5 lbs. was applied. Then a test of 10 and 15 lbs. was applied. No joints leaked. A further test of 20 lbs. was applied and the joints were still tight.

(13) Test to supply data when glazed and unglazed pipe are placed in vertical position, also when pipe is moved before test.—Two lengths of 6 in. pipe, one glazed and the other unglazed, was placed in a vertical position, each being packed with one strand of oakum. Compound was used. After joints had cooled the pipe was laid on a horizontal rack, pipe being supported in three places and a pressure of 5 lbs. applied for ten minutes. All the joints were tight. A pressure of 10 lbs. applied for ten minutes proved all joints tight. A pressure of 15 lbs. showed the joints perfectly tight. Further pressure of 20 lbs. was applied and joints were still tight.

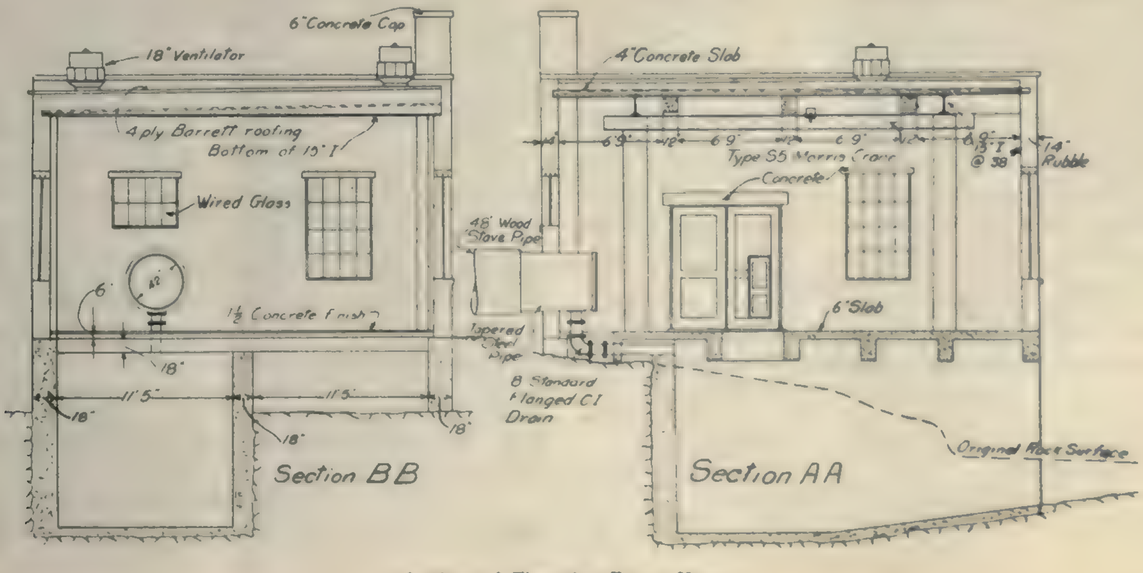
(14) Test to furnish data on tightness of compound joint.—Three lengths of 4 in. pipe placed in an upright position, one strand of oakum being caulked into the annular space. Compound was then poured into the joints. A pressure was then at once applied of 5 lbs., and all joints were tight; then at 10 lbs. and 15 lbs. pressure; all joints were tight. All these joints which up to this fourteenth test had been poured in an upright position have shown no indication of leak and seem to have made a perfect adhesion to the walls of the pipe and to the walls of the bell.

Hydro-electric Plant at Thessalon, Ont.

An Interesting Example of Small Development for Municipal Purposes—Construction Features of This Project

The Thessalon hydro-electric power development, located on the Little Thessalon River at the village of Little Rapids, Ontario, is an interesting example of a small development for municipal purposes. Mention of the project has previously been made in these columns, but it is only recently that details of the work have come to hand.

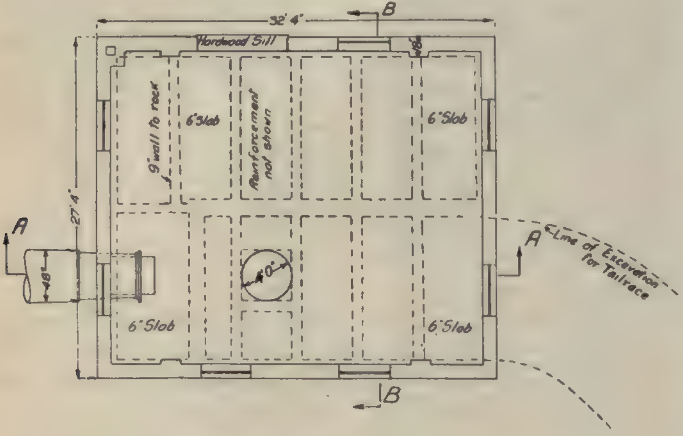
The work entailed includes dam, head works, pipe



Sections of Thessalon Power House

line and power-house. The dam is of concrete and the use of field boulders, of which a large number are on the site, is allowed. It appears that rock excavation will not be necessary to any considerable extent. The existence of a burned log chute, and an old dam are features that have some bearing on the amount of work necessary by the contractor. A total width of approximately 190 feet is spanned by the dam, of which 62 feet is spillway.

The pipe line is of the wood stave type, 1½ inch thick, of B. C. fir. Guarantees of watertightness of joints at power-house entrance, head works and pipe line itself, for 70 foot head, are required from the contractor. The pipe line is approximately 390 feet long, and supports rest on rock. Elevation at dam end is 93.07, at power-house end, 62.0.



Plan of Thessalon Power House

The power-house is to be built 32.4 feet by 27.4 feet, 16.4 feet high. Walls of rubble masonry to roof are specified, with an option of 9 inches hard stock brick. Floor is of concrete with a 1½ inch surface coat. Roof is a 4 inch slab, covered with pitch, tarred felt, and gravel. The accompanying illustrations show further construction details.

The contractor is required to furnish 30 stop logs, and 12 logs for the head works. These are fitted with lifting casting, and a hardwood sill is provided at bottom of chocks.

James, Proctor and Redfern, Limited, are the consulting engineers.

Township of York Sewerage Report

A very comprehensive report on sewerage schemes for southern parts of the Township of York, Ontario, has just been completed by Mr. R. O. Wynne-Roberts, sewerage engineer in the firm of Messrs. Frank Barber and Associates, Ltd., consulting engineers, Toronto, Ont. The report has been prepared on instructions of the Reeve and members of the York Township County, and covers the following proposed sewerage schemes.

1. Danforth Park District—east of Woodbine Heights about	420 acres
2. Todmorden and Greenwood district west of Woodbine Heights, about	800 acres
3. St. Clair Township Zone north of St. Clair Avenue about	2550 acres
4. Keelsdale District west of Keele Street, about	605 acres
5. Swansea, Runnymede and Scarlett Plains Dis., west of city limits about	865 acres
6. Areas contiguous to N. Tor. about	920 acres

The report covers 125 pages typewritten matter exclusive of a large number of maps and drawings. The subject matter is treated under the following chapter headings:—

Preliminary Statement; History of Developments re Sewers; Date required; Growth of Township Population; Separate Versus Combined Sewers; Rainfall; Frequency of Storms; Basis of Sewer Design; Synthetic Method of Designing Sewers; Factors re Financing; Danforth Park District Sewerage Scheme; Todmorden & Greenwood District Sewerage Schemes; St. Clair Township Zone Sewerage Schemes; Keelsdale District Sewerage Scheme; Swansea, Runnymede and Scarlett Plains District Sewerage Schemes; Area Contiguous to North Toronto; Cost of Existing Sewers; Cost of Proposed Sewers per Lot; Estimates Generally; Sewage Treatment; General.

Thirty Seven Reasons Why a Road Contractor May Lose Money

Thirty-seven reasons why a contractor may lose money on highway work were printed in a recent Weekly Letter of the Contractors' Association of Northern California. The notes, which were taken from a paper presented before the Associated General Contractors by H. R. Wilson, are as follows:

1. In general, careless estimating and failure to analyze and anticipate in their bids the many factors to be encountered.

2. Taking the engineer's estimates on work as final criteria of the costs of same and submitting bids below those estimates with the apparent conviction that the engineer computing said estimates possessed some occult powers of divination which made it impossible for bidders to lose money so long as their bids remained within hailing distance of those estimates.

3. Leaving the preparation of their bids to some material or bonding man who was interested in their efforts to secure a particular contract.

4. Applying cost data gleaned from handbooks and trade literature upon the subject and undue reliance on it.

5. Submitting prices merely made to beat the previous low bidders, evidently and alone in the childlike faith that the previous low bidders could have made no mistake, or submitting bids which are nothing more than an average of the bids submitted upon a number of other projects, apparently alike.

6. Failure to give the subject of bidding the time necessary for the completion of a thoughtful bid.

7. Failure to realize the many elements of risk and uncertainty which the specifications usually require the contractor to assume and which should properly be assumed by the state, and failure to cover these elements in their bids by a proper percentage of probable occurence.

8. Failure to take proper account of the hardships so frequently resulting from the elements of risk and uncertainty included in most highway contracts.

9. Failure to recognize the fact that, in normal times, a contract located close to large centers of

population and production, cannot usually be prosecuted on as economical a wage scale as one comparatively removed from competition in this line.

10. Use, in bidding, of lowest quotations on aggregates with out careful examination into the character, suitability, and possibilities for future rejection of the same, as well as the producer's ability to furnish the maximum amount of material when, and as required.

11. Failure to plan unloading and storage facilities so as to permit a producer of small capacity upon whom one may have to depend to make shipments evenly at all times, or to enable stocking of materials to cover strikes, embargoes and other contingencies.

12. Failure to study available labor supply and prices likely to prevail for same during the life of a contract.

13. Failure to study availability of cars and train movements involved with material shipments.

14. Failure to consider whether one will be able to perform a prospective contract with an old experienced organization or with a new organization to be assembled for the work in question.

15. Failure to properly consider probable duration of working season and the expense incident to carrying on organization through the winter, particularly where this expense results from inability to complete project in one season as may be contemplated when submitting bid.

16. Failure to recognize fact that existing sidings for delivery of material may prove inadequate for proper prosecution of work and protection of progress and to include expense for construction of additional sidings or extension of existing facilities.

17. Failure to consider suitability and volume of water supply and the charge for additional equipment which may be necessitated through failure at any time of an anticipated source of supply.

18. Failure to properly consider character of roads available for hauling and the result-transportation costs under all weather conditions.

19. Failure to investigate or consider, as far as practicable, character of engineers and inspectors to be dealt with.

20. Failure to charge off the amount of plant depreciation which may be experienced from a falling market, unsatisfactory machinery purchased or inability to complete work in anticipated time.

21. Failure to properly analyze and consider soil, and topographic conditions, right of way problems, and any structural obstacles along right of way in their relation to wet weather, progress, transportation and resulting costs.

22. Failure to provide for proper and economical sequences of operations and for the most satisfactory and economical equipment for executing work in hand.

23. Failure to charge on estimate for the cost of freight and hauling on small items of supplies, insignificant in themselves individually, but amounting to a large sum in the aggregate.

24. Failure to investigate cost of supplies such as lumber, coal, feed, etc., also leases, rentals, freight on plant, camps, warehouses, plant, traveling expenses, losses on transportation of labor, legal expenses and many other items which might be mentioned in their relation to a particular contract.

25. Failure to recognize that costs used in compiling a bid may have been achieved under the direction of a more competent superintendent and a more efficient organization than you will be able to secure for the prospective project.

26. Failure to consider the existing condition and probable course of the markets during the life of a contract. This factor must always be balanced against cost figures procured from a contract already executed.

27. Failure to study all excavation involved in the field and to work out in advance of bidding an appropriate classification of material to be handled in grading, foundations, ditches, borrow pit, shoulders, dressing slopes, refilling rock breakage in cuts, etc. Almost any constructor can tell you what the total unit cost of excavation was on a particular job, but few can tell how many yards of each of the various classes of material were handled by a particular method and the resulting unit costs. Because of the difficulty and expense necessary to properly keep such costs we not only find constructors' records, but the actual technical literature in existence on this particular subject, very barren.

28. Failure to estimate even approximately on the amount of fence moving, sod, clearing, scarifying and other items which may be included in the excavation price.

29. Failure to approximate average length of haul or overhaul on excavation and borrow.

30. Failure to recognize that, on most road construction in cuts it is impracticable not to excavate a large portion of the shoulders and then replace same without payment for either operation.

31. Incurring heavy demurrage charges through failure to provide for orderly shipment and unloading of materials. (One highway constructor in the East was forced to pay several thousand dollars demurrage in a single season through accumulation of cars due to carelessness in design of unloading plant and ordering of shipments.)

32. Failure to allow an estimate for expense of stocking and rehandling materials and for waste in materials incident thereto.

33. Failure to properly figure average haul on materials for pavement, masonry and other items for the work as a whole.

34. Failure to figure cost of steel bars, pins and filler required for expansion joints.

35. Failure to figure shrinkage as between loose measure and solid measure in the construction of subbase, broken stone base and other foundation courses.

36. Failure in bidding on masonry work to recognize the great variation in the unit costs of labor and other expenses as between bridges, walls and other heavy masonry and pipe head walls. Aside from bridge parapets, the construction of head walls will be found to be comparatively much more expensive than other masonry quantities not only in labor, but also in waste of material as well. (As an instance of this on a road project built in 1920 the cost of rubbing down head walls with labor at $4.50 per day, was found to be 30 cents per cubic yard of concrete placed in head walls.)

37. Failure to make proper charge for supplies required in connection with concrete masonry, tile underdrains and other miscellaneous items of contract work.

The Contract Record's

Weekly House Suggestion

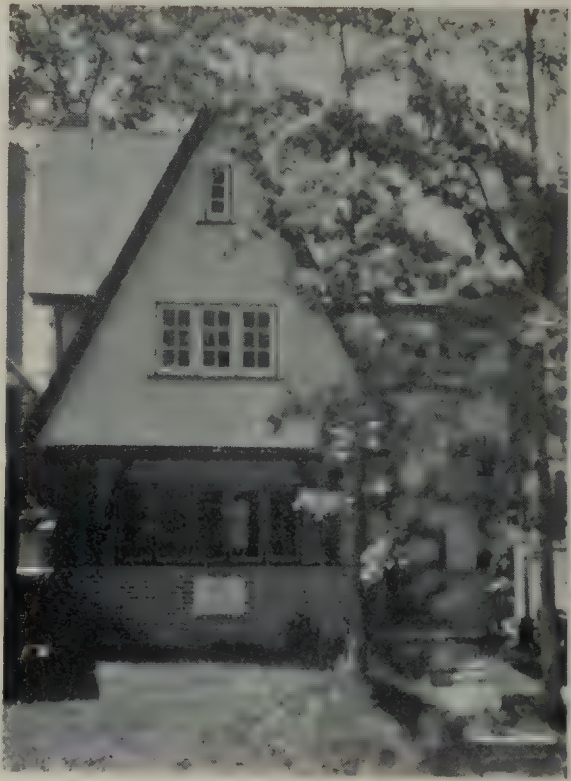
No. 34

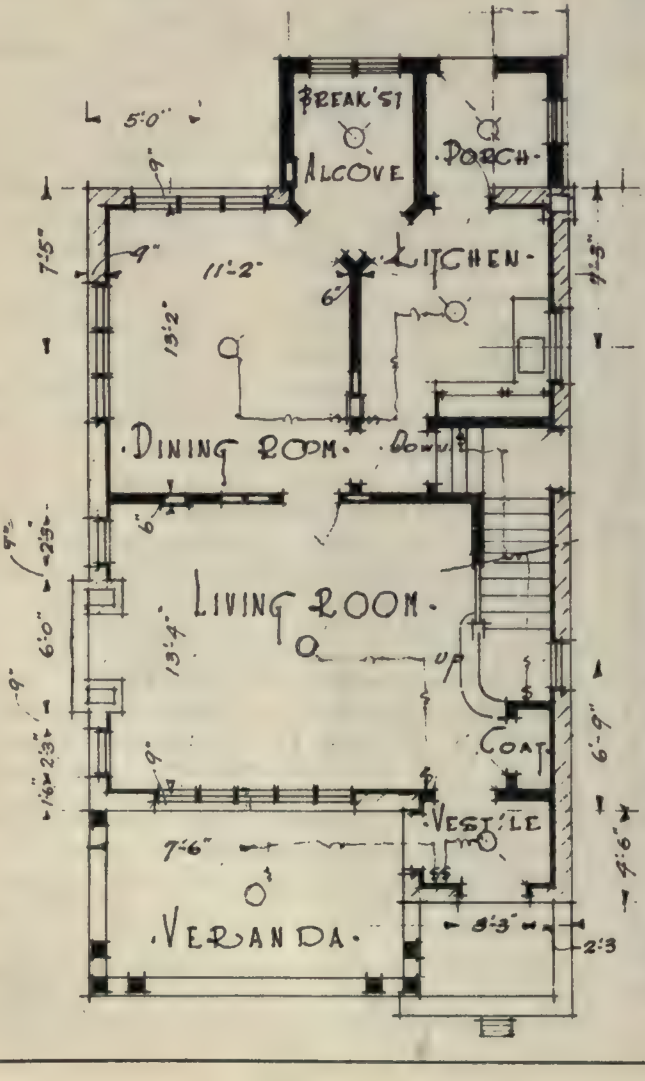
The subject of our series this week is a seven-room residence of unusual, but quaint design, somewhat along English colonial lines. It is of stucco construction on brick, with face brick on verandah. The windows are all of the casement type, white enamel finish, and the roof is of wooden shingles. The verandah is entirely enclosed, with entrance from the front porch at the right. Entrance is directly on the large living room, which has a beautiful brick mantel with tile base in the centre of the left wall. The staircase to the bedroom floor is also situated in this room, as seen on reproduced floor plan below.

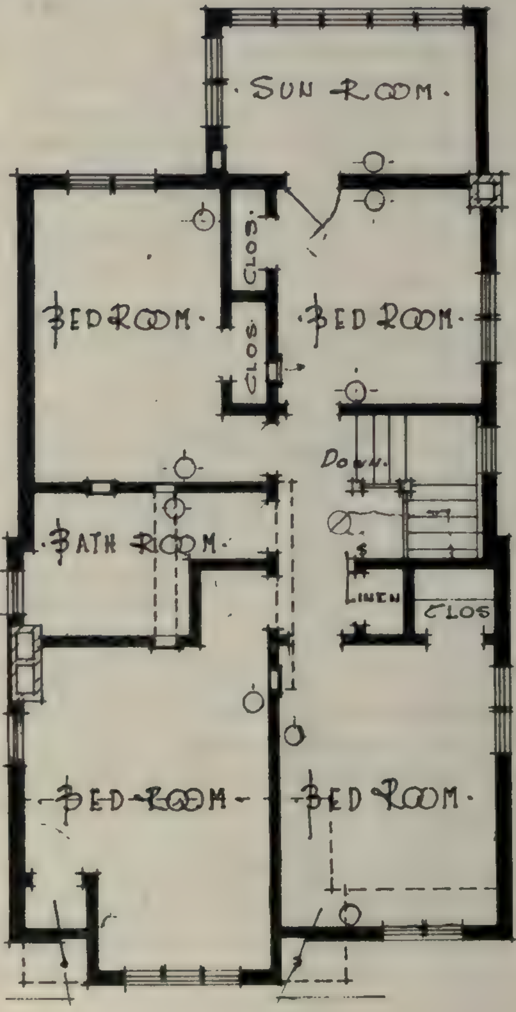
The upper floor contains four good-sized bedrooms, bathroom and sunroom, so laid out that hall space is kept down to the minimum. All rooms are conveniently located off the hall and have ample wardrobe and closet space. The bathroom is finished in white tile and the trim in general upstairs is finished in white enamel.

There is a full size basement under the entire area of the house, containing boiler room, laundry and the usual space for coal and fruit storage.

This is another of Mr. H. Addison Johnston's design and is located on McLean Avenue in the Beach District of Toronto.







Disston Company Now Manufacturing Hand Saws

The firm of Henry Disston & Sons, of Toronto, manufacturers of the well known line of Disston saws, have recently installed at their plant modern machinery for the manufacture of a complete line of hand saws. Until recently the company manufacturd in Canada only the larger types of saws, such as band saws, circular saws, etc., for the lumber trade, but they are now turning out 200 dozen hand saws a week, of the various types, at the Toronto plant and are finding this output entirely inadequate to supply the demand already created. Experts from the Philadelphia plant were brought to Toronto to supervise the manufacture of the hand saws, Workmen thoroughly trained in their respective duties are employed and up-to-date machinery for the various operations has been installed, with the result that the Canadian plant is turning out, in the opinion of one Philadelphia authority, a hand saw that is equal in quality, if not superior, to the product of the parent plant.

On the first of August last the company commenced marketing the Made-in-Canada line of hand saws, at an average reduction of $9.00 a dozen below the previous price of the saws imported from Philadelphia.

A representative of the Contract Record was shown through the Toronto plant recently and the process of manufacture of hand saws was explained to him in detail by the manager, Mr. Dingee. The entire process includes 35 major operations, some of these involving several minor operations, and some idea of the importance of this industry will be given the reader by the accompanying brief outline of the process of manufacture from the cutting of the blands to the packing of the finished product.

Process of Manufacture

The steel is received at the plant in oblong sheets about the length of the ordinary hand saw and the first operation consists in splitting these sheets, each sheet furnishing material for two saws. The outline of the saw is cut from the plate and the next operation is the cutting of the teeth in the plate. One machine cuts uniform teeth in the similar types of hand saws, but a special automatic machine is employed for the cutting of teeth in rip saws, where the teeth are graduated, the teeth at the end or butt of the saw being larger than at the beginning of the blade, the idea being that the carpenter when using the saw requires finer teeth at the front end to allow of easy working into the board to commence the cut. The cutting of the teeth by the machine throws a "burr" along the saw at the base of the teeth, which is removed in the next operation by passing through a roller. The saw then undergoes the process of tempering, the furnaces being controlled by pyrometers, with a heat control arrangement which ensures the exact required temperatures. After passing through the die, the saw is perfectly straight and perfectly tempered and is tested for these qualities, the blade being bent double and required to spring back straight. It is later taken to an instrument which tests the steel for hardness.

The next and a very important operation is that of grinding to the required thickness, it being necessary to give the blade a taper grinding from the line of teeth to the upper edge, to allow of clearness in cut. Following the grinding process, the saw is placed in an electric drier, because if allowed to dry itself, it would rust. Then follows the hammering or tensioning process, which gives the saw its flexibility, after which it is thoroughly examined for proper grinding. The next operation is polishing, the blade being passed through three graduated grades of Turkish emery, the last grade being a very fine emery producing a highly polished surface. A man with a hammer then sets by hand the teeth in the blade, these being staggered, each succeeding tooth in the opposite direction. The cheaper grades of saws are then put into a machine and automatically filed, but the better grades are filed by hand. The name of the firm is then put on the blade by a transfer system, acid being used to etch the name in the steel. The blade is varnished on either side of the name plate for a distance of two or three inches before the acid is applied, however, in order to protect the surface from the acid.

The blade is then thoroughly cleaned of all stain of the varnish and the end is cut the shape of the handle and holes are punched in the b'ade for screws to fasten on the handle. It is given a brushing with oil to remove all finger marks, stains, etc., and receives a final inspection before being placed in individual paper covers and packed four to a box, ready for shipment.

The outlook is very bright for this new branch of the industry, states Mr. Dingee, the company being scarcely able to keep step with the demands of the market.

Mainly Constructional

East and West—From Coast to Coast

Engineers recently completed surveys for the new Grand Trunk bridge at Walkerville, Ont., and are submitting to the town three different designs of this proposed structure for the council's approval.

The new Vancouver Harbor Board consists of Lieutenant-Colonel Kirkpatrick, chairman of the old board, who becomes chairman of the new; R. E. Beattie and S. Prenter. The Board assumed duties on September 1.

Tenders have been called for the first building in connection with the expansion scheme of Trinity College, at Toronto. The total expenditure in this connection will be between $1,000,000 and $1,500,000 and it will require about three years to complete the program.

The construction program of the Ottawa Suburban Roads Commission is very nearly completed for this year. All the roads under the jurisdiction of this commission are now open to traffic and the only work being done is grading, ditching, construction of shoulders, culverts, etc.

The city of Kitchener, Ont., is considering the installation of a sewage disposal plant to take care of that section of the city which it at present without this service. A delegation recently visited the town of Woodstock, Ont., for the purpose of inspecting the plant in operation at this point and were favorably impressed with its workings.

The Provincial Treasurer's Department of Quebec is now installing signs on the national highways, which will prove most advantageous to autoists and others. They should be in place by the middle of September on all the main roads of the Province. These indicating plates are situated at the entrance to villages, towns and cities and contain the name of the place, and the speed allowed in each section.

Toronto Housing Company, Limited, is erecting a block of about 19 houses comprising 40 apartments, at Bain and

Logan Avenues, as an addition to its present property. The buildings will be of solid brick and will have about 350 feet total frontage. Cost of the enterprse is estimated at about $75,000. This addition will bring the number of apartments erected by the company on Bain Avenue to about 300, in addition to 36 on Spruce Court. The houses will be heated from a central heating plant.

The United States Steel Corporation a few days ago announced an advance of 20 per cent. in the wages of day labor effective September 1. thus increasing the scale for a ten hour day from $3 to $3.60. The increase brings the scale almost back to the level which prevailed in July, 1921, when the rate was $3.70 a day. Several other large companies have followed the lead of the United States Steel Corporation, the increase affecting, it is announced, about 300,000 men in all.

The Vancouver Branch of the Great War Veterans Association unanimously endorsed the action of its executive committee with regard to the building of a memorial hall. The proposal of the executive committee is to form a limited stock company for the purpose of securing a site and erecting a memorial building, the company to be incorporated under the name of the "G.W.V.A. of Canada (Vancouver Branch) Building Company Limited," with a capital of $100,000, the par value of the shares to be $1.

Plans in connection with the erection of the Chateau Frontenac addition at Quebec have been changed and an attempt will be made, it is stated, to complete the steelwork for the entire tower structure before the New Year. It was generally understood that this work would be suspended at the 12th storey over the winter period, but work will go right ahead on the remaining 8 storeys. About 475 men are at present engaged on this work and it is expected that the entire job will be completed by the latter part of next summer.

Personal

Hon. Dr. J. H. King, Minister of Public Works, is at present in Vancouver on a business trip.

Mr. Tom Moore and Mr. P. M. Draper were re-elected president and secretary respectively of the Dominion Trades and Labor Congress, at the convention of that body recently in Montreal. Next year's convention will be held in Vancouver.

Mr. Ivan Vallee, Chief Engineer of the Quebec Department of Public Works, left recently for the Island of Orleans, where he will spend several days inspecting the conditions of the five bridges, which have been built on the Island under the supervision of the Department.

The building supply market has been rather quiet during the past month in the Toronto district, the few changes noted, however, have been pretty generally upward. Steel has been the most active line, two or three small advances having taken place during the above period in bars, plates and sheets, and we are advised that another 10c increase will go into effect to-morrow.

Hemlock 2 by 4 to 12" has advanced $2.00 per M. and Fir timbers 10 by 10 in. and up have jumped $5.00 per M. during the past month.

Red pressed brick, in both No. 1 and No. 2 grades, show an increase of about $1.00 per M. over the price of a month ago.

Obituary

Mr. Fredrick R. Miller, prominent engineer and contractor of Toronto, died at the Victoria Memorial Hospital in that city a few days ago. Mr. Miller had been ill since June, having undergone two operations in that time for stomach ailments. He was born in 1878 in St. Catharines, Ont., and passed his early life in Ingersoll, Ont., being educated there at the public and high schools, prior to coming to Toronto University, from which he graduated in engineering. He served from 1902 to 1909 with the firm of Haney and Miller, leaving them to become manager of the Port Credit Brick Company. In 1910 he joined his father's firm, Roger Miller & Sons, as a partner, and became vice president in 1917. Other of his business affiliations were his position as president of Owens and Elmes, Limited, and his position as vice-president of Claburn and Company, Limited, of Vancouver, fire brick manufacturers. Many of the engineering works in Toronto are testimonies to his skill in his profession. He executed many of the Harbor Commission contracts, built the new intake pipe and also erected the sea wall. He first notably entered public life during the period of the war when in 1916, he took charge in the Toronto district of the production of munitions for the Imperial Munitions Board. So successfully did he function in this capacity that his jurisdiction was increased to include the whole province. Later he was appointed by the Imperial Munitions Board to become vice-president and general manager of the British Forgings Company, Limited. In all these positions he served the Government entirely without recompense. He was a member of the Hydro-electric Power Commission of Ontario and of the Toronto Transportation Commission, having supervised the extensive program of rehabilitation work carried out by the latter body last year. He was an ardent enthusiast for motor boating, motoring and golf and was the owner of the motor boatsHeldena I., Heldena II., and Heldena III., the latter winning the International Gold Cup Trophy at the Exhibition races last year. He was a member of the R.C.Y.C., honorary commodore Parkdale Canoe Club, past commodore Toronto Motorboat Club, and member of the Eglinton Hunt, Engineers, Mississauga Golf, Ontario, Albany and Old Colony Clubs, and of the Rideau Club, Ottawa. He had served on the executive of the American Power Board Association.

Fred. R. Miller

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U.S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, September 13, 1922 No. 37

How Bad are Ontario's Roads?

It was to be expected that the Ontario government's road policy would induce criticism from those who were politically opposed, or whose selfish interests were affected, or whose natural dispositions are to be critical of every new or public spirited venture. But is such criticism warranted or does it find justification in any serious errors of judgment or flagrant waste of money on the part of the Highways Department? To our mind, most of the opposition is unsupported by fact and has developed as a result of personal inconvenience in travelling the new highways or because the critic does not see eye to eye with the government as regards the location of the road, its cost, type or some other feature of its construction.

Viewing the matter from a broad angle, one must give the Ontario government a great deal of credit for the very effective manner in which it is handling the highway problems of the province. They are serious problems that demand a well defined policy that will satisfy in the best possible manner the insistent demands for improved road transportation facilities. Such a policy was laid down in Ontario many years ago and succeeding governments have extended it and improved upon it until to-day the province has one of the finest road building organizations on the continent operating on a highway scheme that will ultimately provide the province with roads unsurpassed for the service they will have to render.

This view is confirmed by a recent trip through four of the neighboring states, all noted for the high quality of their "state roads." True, these highways, continuous for hundreds of miles, provide unexcelled touring facilities and offer splendid inducements for the promotion of motor freight traffic—for which purpose they are indeed being taken up—but unlike our own roads, they are purely inter-urban highways that follow along well defined touring routes. They do not tie in with a network of well-drained, well-surfaced roads that reach to the farmer and enable him to market his produce to the best advantage. In other words, the state highways are developed to the detriment of the sideroads.

It is in this respect that Ontario's policy is outstanding. Splendid roads as the 1,900 miles of provincial highways will be when finished, the county and township systems have not been neglected. Indeed, under the policy of government subsidies, the rural municipalities of the province have developed and are continuing to develop a splendid system of highways quite adequate for the needs of the districts they serve. A system of highways reaching, as far as economically desirable, every farmer of the province and enabling him to properly market his produce, is what is required for the proper development of the province and this, we believe, is what Ontario has.

Encouraging Signs

Recent developments are all favorable to the building industry. The Minister of Labor at Ottawa says unemployment is at a minimum; being employed, labor has less time and inclination for agitation; it is likely too, following the experiences of the past couple of years that men will do their best for some time to come to hold jobs that were so difficult to obtain. The coal strike is apparently settled; this means that fuel will be available for industries during the autumn and winter and it means also that building of all kinds, especially houses will be stimulated. A third encouraging feature is presented in the optimistic crop report from the West; from reliable sources we have estimates of record totals and prophecies, at least, of good prices, which seem likely enough in view of the unfavorable crop conditions on the European continent. Finally, we have the general trend of the stock and bond market which has held its own wonderfully well during the holiday season—now giving out the most encougaging reports of activities and advances during the coming winter. Financial men freely discuss "at least two years" of industrial activity as if it were an accomplished fact. Let us hope they know what they are talking about. They do indeed seem to have the faculty of making bigger profits out of our industries than those men do who are actually engaged in operating them.

Altogether the situation at the moment looks very bright and hopeful. If, as we said in a recent issue, the building industry can hold on without having to raise prices and, so, further establish itself in the confidence of the general public, the next two years should be very satisfactory for everybody in it.

The Vitrified Clay Pipe Publicity Bureau, 9 Wellington Street, East, Toronto, has issued an interesting illustrated booklet entitled "Has Your Town a Sewerage System or—Unsanitary Conditions?"

Rapid Progress in the Construction of the Ballantyne Pier

Early Completion of the Structure is Expected—Contractors Have Very Extensive Equipment—Reinforced Concrete Sheds to be Commenced at an Early Date

By J. B. HOLDCROFT, A.M.E.I.C.
Contract Record Correspondent

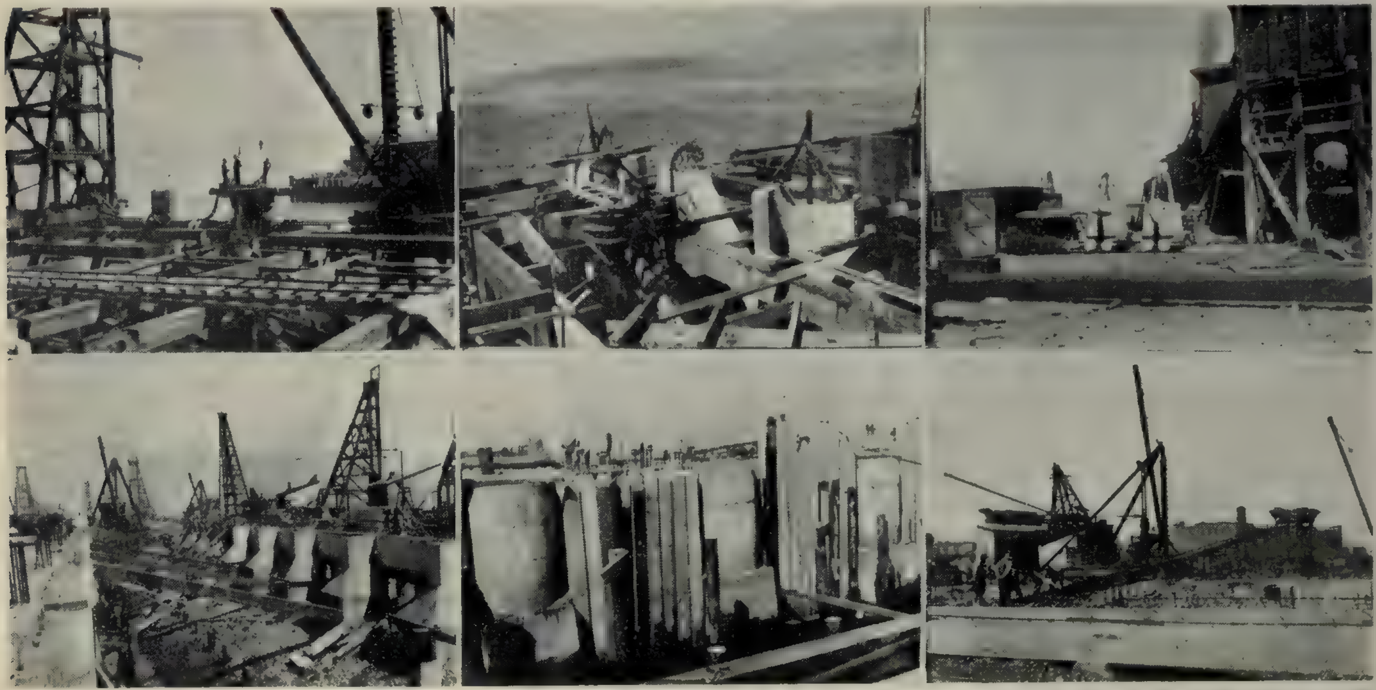
Rapid progress is being made on the construction of the Ballantyne Pier at Vancouver, B. C. The west side of the structure is now approaching completion and work will very shortly be commenced on the construction of the first two of the four reinforced concrete pier sheds. A delay of about three weeks has recently been caused, however, by a mishap at the deep water end of the pier, occasioned by the breaking or washing out of a temporary wooden pile, the failure of which let down one of the big derricks. Serious injury to a number of the workmen was only narrowly averted at the time of the accident by their presence of mind in instantly jumping off the structure into the water, whence they were speedily picked up. At this end of the pier the water is about ninety feet in depth and at certain stages of the tide there is quite a strong current, which is thought to have partly washed out the bottom of the pile which failed.

Foundation cylinders have all been placed on the west side and work is proceeding on those at the pier end and along the east side. Owing to the great depth at the end of the pier, some of these cylinders are as much as one hundred and ten feet in length. A number of difficult problems have developed from time to time in connection with this most interesting feature of the work, some of which were described in a previous article on this project. Cylinder shells and their connecting trusses have all been precast, with reinforcing rods left protruding at the points of junction to furnish a bond when the work was assembled. The longitudinal girders and the deck are cast in place in the ordinary manner, and with the cylinders filled with concrete and girders and floor slab poured, the whole becomes thoroughly homogeneous and rigid.

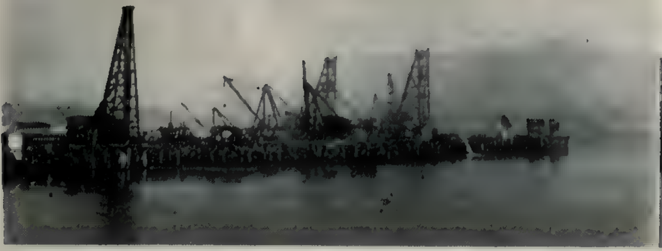
Extensive Construction Plant

The construction programme has been carefully arranged by the contractors, the Northern Construction Co. and J. W. Stewart, so as to keep the massive units of plant moving around the work, commencing at the shore line on the west side, and finishing at the east side shore, so that a trip over the job reveals work going on in practically every stage of the construction. The contractors have spared no expense in gathering an equipment sufficiently comprehensive to ensure rapid completion of the project, and it is expected that the pier will be in shape to turn over to the Board of Harbor Commissioners in about twelve months' time.

Six great derricks specially designed for the pur-



Upper left; Jetting down concrete foundation cylinder on east side of pier. Upper centre: Method of assembling pre-cast truss units with cylinder heads. Upper right: The concrete mixing plant, showing bunkers, mixer and train of bottom-dump buckets with gasoline locomotives. Lower left: On the right, foundation wall and piers for shed; on the left, edge of concrete deck with close concrete piling driven to hold fill: central space to be filled up level. Lower centre: Close concrete pile retaining wall between cylinders of inner row west side, to retain fill under freight sheds. Lower right: Sluicing gravel into fill on site of pier shed.



General view of construction work on off-shore end of pier

General view of construction work on shore end of pier, east side. Placing cylinders. Floating concrete plant at left

pose have been constantly in use for setting cylinders and a large amount of special tackle has also been required for properly handling the unwieldy sections weighing ten tons or over. The cylinders have been sunk to rock or a thoroughly firm foundation in all cases, and jetting has been largely used in connection with the sinking. Excavation inside the cylinders has been by open dredging, a small orange-peel bucket being used for the purpose.

In addition to the large special derricks, six of the ordinary stiff-leg type are in use for various purposes, some fixed on the false work, and others on scows as floating equipment. There is also a locomotive crane constantly employed for many purposes where a light crane of mobile type is most useful. There are two concrete mixing plants, one floating, and the other a fixed central plant from which is supplied the concrete for pouring the girders and floor slabs of the pier deck. From the central mixer the material is transported to the work by narrow gauge railway, three small gasoline locomotives and a number of cars with removable bottom dump buckets being used for this purpose. There is also a complete system of shops in connection and a large compressor plant in addition to the many smaller details of plant inseparable from such a large undertaking. This does not include an entirely separate and very large plant established at a point about three miles away on the north shore of Burrard Inlet for the manufacture of cylinder shells and the precast units of the stiffening trusses.

Construction of Sheds

In preparation for the construction of the sheds, which is to proceed immediately, a good deal of work is in progress with a view to levelling up the central fill under the shed area. As has been previously stated, the pier is of the type which is built over a gravel fill, brought up to grade in the center, where the roadways and tracks will be located, and sloped away on about a two to one grade underneath the reinforced decks at the sides. The inner sides of the sheds will rest on this fill near the top of the slope, and special piers with broad bases have been built in to carry the walls. A space of about thirty feet exists between this line of piers and the inner edge of the concrete deck, and this space is being filled in to the deck level with gravel, a row of concrete piles driven closely together along the inner edge of the deck acting as a retaining wall. The material for this extra fill is being brought to the side of the pier on scows, and dropped into hoppers by a clamshell handled by a floating derrick. From the hoppers it is sluiced down a chute into place.

The sheds will be of reinforced concrete construction throughout, and will be two storeys in height. Each will be 500 feet long and the construction will be expedited by a set of steel trussed forms fitted so as to be rapidly and easily movable. These forms are now being assembled on the job, and with the early completion of the foundation work and gravel filling in sight, notable progress on this portion of the work should soon be made.

Tenders are now being called for by the Board of Harbor Commissioners, closing on October 2, for the supply and installation of the cargo handling equipment for the pier, which will be of the most modern type. This will include eight electric cranes of the semi-portable type, with a maximum outreach of 45 feet. These will be of 3 tons capacity and are to have a full load lifting speed of 175 feet per minute. There will also be four electric freight elevators having a speed of 60 feet per minute with a 9 ton load, and four escalators, capable of handling single packages up to 1,000 lbs weight. Other details will include electric capstans, and a number of tractors and trailers.

Alterations to the Bank of Nova Scotia, Vancouver, B.C.

Extensive alterations are under way at the Vancouver, B. C., office of the Bank of Nova Scotia, on the corner of Hastings and Seymour Streets. The work will include a considerable enlargement of the main banking floor, which has its entrance on Hastings Street. The additional space will provide a larger section for the public as well as extended quarters for the clerical staff.

One feature of the alterations is the installation of vaults and safety deposit boxes in the basement of the building, and it is stated that a new public entrance and stairway is to be constructed to give access to this portion of the bank's quarters.

A good deal of new fixture work will also be done, both on the main floor and the basement and in connection with the safety deposit section a certain amount of steel grille work will be required.

The work has been let to Messrs. Hodgson, King and Marble, of Vancouver, engineers and contractors. The bank officials are reticent as to the total amount of the estimated cost of the work to be done, and emphatically deny the correctness of figures published locally in connection with the award of the contract. It is understood, however, that a very considerable expenditure is involved.

Aeration of Sewage for Small Towns

How Small Communities May Adapt a Natural Method of Purification to the Treatment of Sewage

By **W. G. CAMERON, B.A. Sc.**
Assistant Engineer, Sewer Section, Works Department, Toronto

Many a small town or community will look with envious eyes these days at the large cities where great sums of money are being expended to instal the most modern plants for the treatment of sewerage. In the past some places have installed septic and sedimentation tanks; others, as research progressed, have availed themselves of its discoveries, such as Imhoff tanks, but the latest form of treatment is aeration of sewerage and one wonders how long it will be before some other and better method of treatment will be discovered.

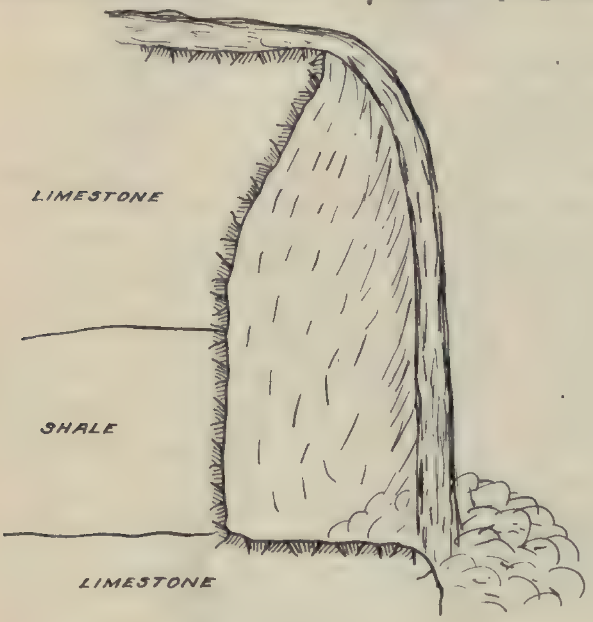


Fig. 1

In this present eagerness to obtain the best service which research has discovered for the treatment of sewerage, one fact has been almost entirely overlooked, that is, that one of nature's methods of purifying water is by aeration. This, accomplished by passing water over rough places, such as rapids and falls, along with bright light, filtration and sedimentation, constitutes nature's purifying equipment. This, of course, serves the full requirements of a state of nature, but these methods have to be adopted to the requirements of civilization. This modification is partly accomplished in the activated aerated methods of the present day.

We have a splendid illustration of nature's method at Niagara where the water, after passing down the river through many rapids, falls over the cliff, passes on through more rapids and on to the lake, thus providing purification for the water and also one of Nature's beauty spots. At the Falls, we have some of the water churned up into fine spray which mixes with the air and then again, owing to the composition of the rock which forms the cliff (Fig. 1), we have a portion of the Falls beating down on a hard surface which compresses the air behind the Falls to an extent of 1½ lbs. over atmospheric pressure. This air escapes through the body of water from time to time, giving the effect of the spray bouncing into the air in small sections from its normal position.

On looking over the report of the International Commission on the pollution of boundary waters, we find that owing to the greater population on the American side above the Falls, we have a greater degree of pollution than on the Canadian side, thus making it impossible to make uniform tests. But we are given the results of tests taken about June 1, 1913, below Goat Island, as 2,200 B. Coli per 100 c.c. and June 14, below the Falls, where the water is uniformly polluted, as 2,020 B. Coli, and at the mouth of the river as 2,016. We may assume from this that the river, which provides all the agitation and aeration that could be desired, does not have an opportunity to allow any sedimentation until the water reaches the lake, where the water is polluted as far as the current carries the river water. We observe from these figures that although there is considerable sewerage added between the Falls and the lake, from both sides of the river, there is no increase in pollution between these points and we may assume that this was stayed by the water passing through the lower rapids.

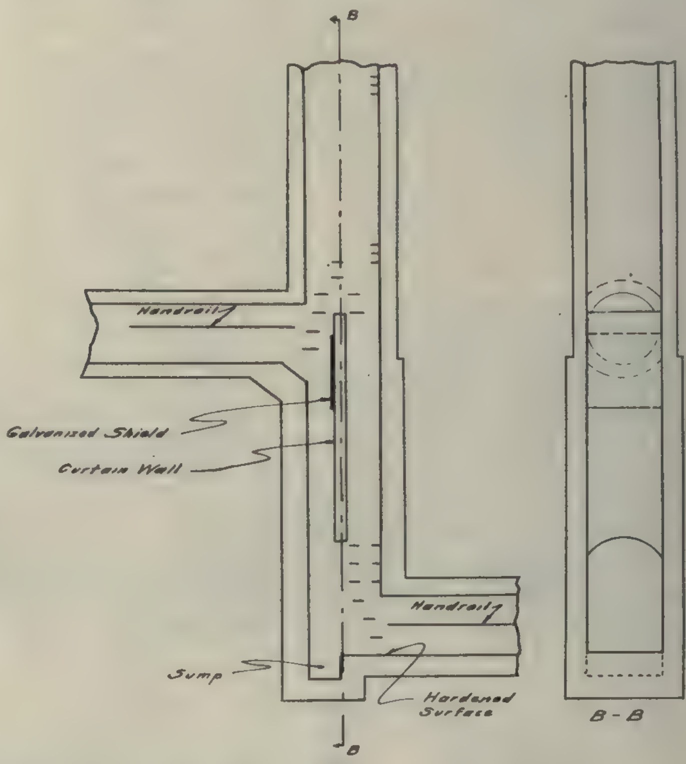


Fig. 2

It is suggested that the smaller communities would do very well to adopt this method of nature-purifying the sewage by aeration. It is an inexpensive method and can be accomplished by building drop manholes, as shown in Fig. 2. As will be noted, the shaft is divided for ventilation in the time-worn way. This dividing wall also provides a surface hardened by any of the methods in present use opposite the upper sewer. The drops would take the place of the present ramps and ornamental stacks could be provided beside nearby walls to carry off any odors which might be produced. Another, but somewhat more expensive way, for a place where the grades prohibit drop manholes, would be to place water wheels in the sewer, the power to run which would be compensated for in the grade. The ends of the axles would have to run in slots that the wheel might rise and fall with the flow. The efficiency of these wheels could be increased by causing them to operate small air pumps, the air from which would be brought back to the axle of the wheel or led to a perforated pipe in the invert.

In this suggested treatment, there is no provision made for sedimentation, but if the treatment does no more than prevent the increase of B. Coli colonies, it has indeed accomplished something well worth while and also discharges the polluted water into its basin loaded with air or oxygen, so that sedimentation can take place without causing the usual amount of pollution of this basin.

New Type of Structural Steel Bridge

360-Foot Steel Arch Has Protective Covering of Gunite—Investigations of Different Types Lasted Two Years

Structural steel has again proved its economy and practicability in bridge design as evidenced by its use in the new highway bridge over the Willamette River at Oregon City, Ore., for the Oregon State Highway Commission. The bridge is of unique design and structural steel was decided upon after very extensive comparative investigations, covering two years, into seven distinct types of construction had been made.

The structure is 850 feet in over all length, having two concrete approaches of the beam and girder type and a centre arch of 360 feet centre to centre of piers or 350 feet between skew backs. The arch is composed of structural steel with a protective covering of gunite.

The bridge is the connecting link in the highway between Oregon City and Portland and is subjected to exceptionally heavy truck traffic, as well as a large volume of pleasure and pedestrian travel, and is exposed to an atmosphere which is at times more or less charged with sulphurous anhydride. The location of and condition surrounding the bridge, therefore, constituted an engineering problem which required considerable thought.

As stated above, several different types of designs were investigated, only to be abandoned in favor of the type adopted. These designs were as follows:—

1. Suspension span—Abandoned because of the excessive cost of making the structure rigid enough for the heavy traffic and also because of the impracticability of protecting the steel from corrosion.

2. 3, and 4. Cantilever, simple truss span and spandrel braced framed arch; all abandoned because of the difficulty of securing a suitable protective covering.

5. Reinforced concrete arch—This was tried, but was abandoned owing to the great cost of the form work and the great depth of the river channel, coupled with the fact that the channel must remain open for navigation.

6. Steel arch bridge with poured concrete covering—This type was investigated but was given up owing to the excessive weight and extreme stresses placed on the structural steel. This last named design finally led to the one adopted where a structural steel arch was used with a light protective covering of gunite.

This design consists of a 360 foot arch with the two concrete approaches with a roadway of 19′ 0″ clear and two 4′ 6″ sidewalks. It is designed as a half-through span to provide the required vertical and lateral clearance for navigation.

In erecting the structure the steel ribs were erected first and swung into place as a three-hinged arch. As soon as this was done, and the lateral system was in place, thirty feet of the rib at each skew back was completely encased and filled with concrete, thus rigidly fixing the ends. The crown hinge was then replaced by a heavy splice plate connection designed to transmit the maximum thrust, moment and shear, at the crown. This done, the rib became a fixed member or a hingless arch.

The main arch rib was of the box girder type and was composed for the rib, of four 8 x 8 x ⅝ flange angles, two web plates ½″ x 120″ (approx.) four flange plates 16″ x ⅝″, six longitudinal stiffener angles 6″ x 3½″ x 5/16″ and two longitudinal stiffeners 6″ x 6″ x ⅜″. The crown was composed of four flange angles 6″ x 6″ x ⅝″, two cover plates 30″ x ½″, two web plates 72″ x ⅜″ and six longitudinal stiffener angles 6″ x 3″ x 5/16″.

Diaphragm plates were used to stiffen the rib. These plates had manholes cut in same so as to allow inspection of the inside of girder at all times. Manholes were also left in the cover plates at convenient points to allow access to the girder. These were covered with removeable hatches.

After the steel arch was completed the inside of girders were given a ¾″ covering of gunite and the outside a 1½″ covering. The floor members, struts and hangers were all of structural steel encased in gunite. The total cost of the structure was $213,602.

Relation of Motor Trucks to Highway Construction and Maintenance

By J. G. McKay

The true purpose of an improved highway is a high degree of transportation service at the least possible cost to the public and road user. Clearly a traffic census is not a panacea, but I insist that without a knowledge of the actual traffic, speed, type and weight of a given area, we are working in the dark. The actual traffic in terms of volume, density, speed and unit weights, must be correlated with laboratory and experimental impact tests as a guide to rational design. Indepently each type of research is valuable, but the true worth of both cannot be realized until combined —in other words, interpreting the results of laboratory experiment in terms of vehicles on the highway.

Construction Developments During the Month of August

Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded and Contemblated

Construction Contracts Awarded in Eastern Canada, August, 1922

	Ontario		Quebec		New Brunswick		Nova Scotia		Eastern Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	3	$ 55,000	4	$ 279,000	....	$..........	....	$..........	7	$ 334,000
Churches	15	342,900	4	406,000	1	55,000	....	....	20	803,900
Factories	11	1,278,000	4	110,000	....	....	....	....	15	1,388,000
Public Garages	9	59,300	26	60,000	....	....	....	....	35	119,300
Hospitals	2	197,700	3	280,000	....	....	1	100,000	6	577,700
Hotels and Clubs	5	135,000	2	530,000	2	175,000	1	8,000	10	848,000
Office Buildings	5	71,000	1	9,000	....	....	1	15,000	7	95,000
Public Buildings	6	217,500	....	....	2	2,600	1	1,100	9	221,200
Residences	946	4,562,300	476	2,258,300	12	69,400	35	140,500	1469	7,030,500
Schools	26	1,468,100	7	405,500	....	....	2	72,500	35	1,971,100
Stores	40	573,500	11	136,000	....	....	....	....	51	709,500
Warehouses	9	368,000	4	41,000	1	7,000	2	11,000	16	427,000
Total Buildings	1077	$9,328,300	542	$4,514,800	18	$309,000	42	$348,100	1681	$14,540,200
Bridges	14	$ 108,900	....	$..........	3	$ 28,900	2	$ 9,000	19	$ 146,800
Dams and Wharves	3	95,800	4	626,700	....	....	2	34,500	9	757,000
Sewers & Watermains	13	451,700	4	65,000	....	....	....	....	17	516,700
Roads and Streets	28	705,800	11	420,100	....	....	3	45,000	42	1,170,900
General Engineering	18	3,292,400	2	296,000	1	100,000	4	165,500	25	3,853,900
Grand Total	1153	$13,982,900	563	$5,922,600	22	$437,900	53	$602,100	1793	$20,985,500

Construction Contracts Awarded in Western Canada, August, 1922

	British Columbia		Alberta		Saskatchewan		Manitoba		Western Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	1	$ 3,500	....	$..........	....	$..........	....	$..........	1	$ 3,500
Churches	4	30,500	3	17,500	....	....	....	....	7	48,000
Factories	2	1,260,000	1	1,000	....	....	....	....	3	1,261,000
Public Garages	2	11,000	...	....	2	12,500	....	....	4	23,500
Hospitals	1	6,300	....	....	....	....	....	....	1	6,300
Hotels and Clubs	1	10,000	3	16,000	....	....	....	....	4	26,000
Office Buildings	2	17,000	2	25,000	1	8,000	3	228,500	8	278,500
Public Buildings	....	....	1	4,000	1	37,000	....	....	2	41,000
Residences	126	511,400	54	193,400	38	115,000	114	424,200	332	1,244,000
Schools	21	103,000	24	344,200	7	69,400	3	14,000	55	530,600
Stores	14	196,800	12	101,400	6	36,000	9	43,000	41	377,200
Theatres	1	12,000	....	....	....	....	....	....	1	12,000
Warehouses	5	82,100	1	7,000	6	55,000	1	6,900	13	151,000
Total Buildings	180	$2,243,600	101	$709,500	61	$332,900	130	$716,600	472	$4,002,600
Bridges	....	$..........	1	$ 10,000	....	$..........	3	$ 14,600	4	$ 24,600
Dams and Wharves	2	27,700	....	....	....	....	....	....	2	27,700
Sewers & Watermains	2	47,500	2	25,900	1	10,000	2	5,200	7	88,600
Roads and Streets	2	6,300	....	....	4	34,200	....	....	6	40,500
General Engineering	2	18,000	....	....	....	....	....	....	2	18,000
Grand Total	188	$2,343,100	104	$745,400	66	$377,100	135	$736,400	493	$4,202,000

Contemplated New Construction Work in Canada, August, 1922

	Ontario		Quebec		Maritime		Western		Dominion	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	6	$223,000	....	$..........	....	$..........	3	$ 77,000	9	$ 300,000
Churches	9	189,000	2	65,000	....	....	3	9,500	14	263,500
Factories	11	407,000	7	1,967,000	2	330,000	4	135,000	24	2,839,000
Public Garages	6	66,000	1	10,000	1	8,000	2	10,500	10	94,500
Hospitals	4	355,000	1	150,000	1	20,000	2	125,000	8	650,000
Hotels and Clubs	5	136,500	....	....	....	....	5	125,000	10	261,500
Office Buildings	9	234,500	....	....	....	....	3	34,000	12	268,500
Public Buildings	10	712,000	3	31,100	2	27,000	4	32,000	19	802,100
Residences	114	822,500	62	411,000	8	38,000	30	168,600	214	1,440,100
Schools	30	2,570,000	19	259,000	3	70,000	27	196,500	79	3,095,500
Stores	22	257,000	2	27,000	....	....	13	256,800	37	540,800
Theatres	1	25,000	1	10,000	....	....	....	....	2	35,000
Warehouses	3	75,000	....	....	1	30,000	13	233,500	17	338,500
Total Buildings	280	$6,072,500	98	$2,930,100	18	$523,000	109	$1,403,400	455	$10,929,000
Bridges	10	$ 42,000	7	$ 111,000	7	$ 66,000	9	$1,440,000	33	$1,659,000
Dams and Wharves	3	37,000	7	2,069,000	3	50,000	6	51,000	19	2,207,000
Sewers & Watermains	21	609,300	4	193,000	....	....	9	86,100	34	888,400
Roads and Streets	23	638,200	58	1,629,500	1	10,000	12	249,900	94	2,527,600
General Engineering	4	78,000	3	80,000	1	130,000	2	215,000	10	503,000
Grand Total	291	$7,477,000	177	$7,012,600	30	$779,000	147	$3,445,400	645	$18,714,000

Estimating the Cost of Stone Work

The Article Shows How to Calculate the Cost of Constructing Stone Foundations—Getting Out the Stone, Preparing It, Laying It and Pointing It

By CHAS. F. DINGMAN, M.Am. Soc. C.E.

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While it is true that stone-foundation work has been almost entirely superseded by concrete in many parts of the country, it is essential that the well-informed estimator be familiar with the method of figuring its cost.

It is also improbable that the time will ever come when there will not be some call for high-grade jobs of rubble stone work, because no other form of construction can produce the same variety of artistic effects.

This article will not attempt to cover the subject of estimating the cost of setting cut-stone, architectural terra cotta, artificial stone, or cement blocks. This will be thoroughly discussed in a later lesson.

Since the range of sizes and shapes of stones available for rubble stone work will vary widely—hardly any two lots of stone will work out alike—it is not practicable to develop as detailed, or as accurate, a method of estimating as is practicable for brickwork or for concrete work.

This makes it necessary to resort more to the method of assumptions than when estimating brickwork or concrete but, nevertheless, the estimator should strive to accumulate all the experience data that he can, taking care to record his data so that it can readily be used for the purpose of estimating these features of any new work that are comparable with similar features of previous work.

In a later article, we shall take up the subjects of cost-keeping, cost-distribution, etc., and show a variety of means to be used for getting accurate cost-records and for eliminating all of these unnecessary operations that creep into any but the most carefully considered cost-accounting systems.

In the meanwhile, however, you will do well to record the cost, in man-hours of the various operations on any rubble-stone job coming under your observation and to compare them with the information contained in this lesson.

As we have stated previously, it is not so much our intention to furnish you with complete estimating data as it is to develop those of your own abilities that will serve to make you a competent construction-manager.

Therefore, the more work that you do, along the lines just suggested, the more intimate will your knowledge of building construction and construction costs become and you will also find yourself developing that keen judgment that is so necessary for success.

Cost of Obtaining Stones

In some portions of the country, it is quite unusual to build stone foundations from old stone fence-walls and, when this is done, the question of estimating the cost of obtaining the stones is very simple.

In other cases, when it is necessary to obtain the stones from the field, the cost can only be obtained by determining, as nearly as possible, the necessary time required to assemble them into piles and load them into carts or wagons, and this time will be determined by the frequency or scarcity of stones in the field that are suitable for use in the work.

Where the stones can be taken from a gravel-pit or from a fence-wall and the sizes are such that they can be loaded by hand, the following figures may be used:

Table I—Getting Out the Stone

Time in Labor Hours per Cu. Yd.

	From Pit to Wagon	From Wall to Wagon
Small round cobbles or boulders	0.72	0.66
Large round cobbles or boulders	0.78	0.70
Small split stones	0.67	0.60
Large split stones	0.75	0.65

When it is necessary to wheel the stone from the pit or wall to the wagon, the cost must be figured as an extra to the above and one man can load and move one cubic-yard of stone an average of 100 feet per hour.

When figuring the quantity of stone and mortar required, allowance may be made for the various openings in the wall and the actual cubical contents taken but, when figuring the cost of the labor, it is well to remember that stone-masons who take rubble-stone work by the sub-contract usually insist upon measuring entirely around the outside of the foundation and not allowing for any ordinary openings.

They usually also insist upon figuring upon a minimum thickness of eighteen inches, no matter what the actual thickness of the wall may be.

This is done because there is practically no available data as to the cost of building jambs and corners, so the assumption is made that the saving by reason of the openings will balance the added cost of the jambs and corners. It is also assumed that it takes just as long to build a wall twelve inches thick as it does to build a wall eighteen inches thick, because of the greater care required in selecting stones and plumbing the wall.

Table II—Building the Wall

(One-and two-man stone)

Hours Required per Cubic Yard

	18" to 30" thick		30" to 48" thick	
	Flat Split Stone	Cobbles	Flat Split Stone	Cobbles
Masons	2.5	6.25	1.75	5.25
Laborers	2.5	5.25	2.5	5.25
Cu. ft. Mortar per cu. yd.	7	7	8	8

Scaffolding for all walls over four feet in height must be figured as explained in the following lesson and added to the costs obtained from these figures.

It was formerly the custom to pay for stone-work by the perch, and I believe that unit is still in vogue in many parts of the country, but just what constitutes a perch seems to be subject to some disagreement. The most commonly accepted definition is

16.5 square feet of 18-inch wall or 24.75 cubic feet. For this reason, I recommend the cubic-yard as the most satisfactory unit for use in figuring rubble stone-work.

The more nearly rectangular in shape the stones are, the less mortar will be required for laying with a given thickness of joint and the amount required increases.

The following tables will give the time necessary will also be less as the size of the individual stones to prepare the stones and lay them:

Table III—Preparing Stone

Production in Square Feet per Hour, Cutter's Time

	Freestone	Granite
Hammered Faces	1.25	1.
Beds & Builds	2.50	2.
Fine Hammering	0.50	0.40

Table IV—Laying Stone

Labor Hours per Cubic Yard

	Cobweb Rubble	Random Ashlar	Coursed Ashlar Course up to (18" high)	Coursed Ashlar (Courses 18" to) (32" high)
Mason	6.25	7.	6.	5.25
Laborer	4.75	5.	6.	5.25
Cu. ft. Mortar per cu. yd.	4	4.	4.	3

When the individual stones run much over one-half cubic foot each, it is usually necessary to set them with a derrick. For most ordinary work a hand derrick will give very efficient service but on large operations, a power derrick can be employed.

In addition to the actual cost of laying the stones in the wall, a very important item in the cost of stone-work is that of pointing the exposed areas and, since the kind and quality of work demanded varies greatly, the cost varies accordingly. Table V gives the data necessary for computing the cost of the labor.

Table V—Pointing*

Square Feet of Surface per Hour

	Mason	Laborer
Flat Stone Work, Joints Raked Out	20	60
Small Cobble Work Joints Raked Out	20	60
Large Cobble Work Joints Raked Out	30	90
Cobweb Rubble Joints Raked Out	30	90
Random Ashlar Joints Raked Out	30	90
Coursed Ashlar Joints Raked Out	30	90
Cobweb Rubble Smoothed Joints	20	60
Random Ashlar Smoothed Joints	20	60
Coursed Ashlar Smoothed Joints	20	60
Cobweb Rubble Ribbon Joints	10	30
Random Ashlar Ribbon Joints	10	30
Coursed Ashlar Ribbon Joints	10	30

*Note—This table is based upon having one laborer tend three masons, if that ratio cannot be maintained proportionate allowance must be made in the estimate.

Good progress is reported on the new Walkerville High School and it is anticipated that the building will be ready for the coming school session. A large staff of workmen are busily engaged in applying the finishing touches, such as painting, cleaning, hanging of doors, etc.

The new filtration plant at Lauzon, P. Q., was officially opened recently by Mayor Dorval. The new plant has a capacity of 1,200,000 gal. per day, although the present needs of the town are but 600,000 gal. a day. The plant is the latest up-to-date sand filtration type and cost upwards of $60,000. It was installed under the supervision of Mr. Hamel, town engineer.

Progress on Main Street Regrading, Vancouver

Pavement Being Completed and Car Tracks Laid—Supporting Cylinders of Dock Walls Repaired with Gunite

With the permanent pavement now practically ready for the wearing surface, the Main Street regrading scheme, Vancouver, B. C., is nearing completion, as far as the actual roadway portion of the scheme is concerned. The pavement, which has a concrete base, will have a 3 inch bitulithic or similar wearing surface, and is built to stand the heaviest traffic, Main Street being the principal artery out of the city towards the cities of the Fraser Valley.

The sub-foundation is sand, deposited by hydraulic dredge on the reclaimed mud flats of this portion of False Creek, which is now the terminal yard of the Canadian National Railways. Reclamation of the area included in the Main Street work has only recently been completed, as the filling in of this portion had to be delayed pending the completion of sewers and main surface drains, and the making of the necessary connections with the wall of the docks which separate the reclamation area from False Creek itself.

Setting trolley poles, completing pavement and setting brick gutters on Main St., Vancouver, B.C.

Work in hand on the scheme at present includes completion of the paving, which is being finished with gutters of paving brick and granite setts at the raw ends of intersecting streets pending completion of the system of roadways included in the scheme of beautifying the area in front of the Canadian National Station. Double lines of car tracks have been laid, with granite setts along the rails, and the construction crew of the B. C. Electric Railway Co. is at present busily engaged in installing the overhead work. Hollow steel welded poles are being used as trolley wire supports.

Incidental to the work in hand on the general scheme, the city works department is carrying out some repairs on the supporting cylinders of the overhang of the dock wall. These were built a number of years ago when the scheme was first undertaken, since when various causes have contributed to the delay in the completion of the work.

These cylinders have been affected to some extent by the salt water of False Creek, which is a tidal inlet, and the work now in hand consists of chipping the affected areas with a pneumatic chisel and coating the parts with a thick layer of cement mortar. This is being successfully applied by the cement gun, and makes a neat repair of good appearance in a very economical manner.

B. C. Woods Appeal to House Builders

Demonstration Suite of Rooms Effectively Displays the Advantages of Western Woods—Exhibit of Great Service to Architects and Contractors

By L. L. BROWN
British Columbia Lumber Commissioner, Toronto

The beauty and utility of British Columbia woods are being demonstrated in an effective way in the form of a permanent exhibit of a suite of rooms, comprising a living room and a dining room with outside walls and roof complete, which have been built on the ground floor space of the British Columbia Lumber Commissioner's office at 51 Yonge Street, Toronto. This exhibit represents a co-operative effort by the British Columbia provincial government and the lumber and shingle interests of the province.

The whole is a studied attempt to show the people of Eastern Canada the full beauty of British Columbia woods when used in the construction of Canadian homes, for it is felt that the sturdy woods of Canada provide both beauty and strength required for even the most palatial abode.

Heretofore, the intending builder has had to visualize from small samples just how a completed room would appear in these woods, but now even the layman may see at a glance just how beautiful his home may be made by the use of Canadian grown woods. And when he considers that these effects are obtained at about half the cost of using imported hardwoods, he will at a glance see the advisability of embodying them in his future home. Already a great deal of favorable comment and even astonishment has been expressed by architects, contractors and homebuilders upon the natural beauty of the woods used and their adaptability for even the finest class of homes.

This illustration shows the attractiveness of Douglas fir panelling

The living room, which is about 13 ft. by 16 ft. is panelled in British Columbia Douglas fir. Flat grain three-ply wood is used in the panels proper and edge grained wood is used for styles and rails and general trim. At one end is a large inviting brick fireplace. The ceiling is beamed and with solid Douglas fir beams with three-ply cottonwood panels between. The room is finished in artistic subdued tones which bring out the natural beauty of the wood to splendid effect.

Passing through an arch, one enters the dining room which is about 12 feet by 16 feet 6 inches. This room is complete in every way with built-in china cabinets, small bay windows, brick and stone fireplace and French doors. The walls are panelled in Western hemlock; the panels proper being of flat grained style, rails and trim.

A great deal of surprise concerning this wood is expressed by architects and homebuilders for they have been apt to confuse Western hemlock with the Eastern variety of the same name, which is only used for the roughest work. But a study of this beautiful room shows that Western hemlock has little in common with the Eastern variety for it is a high grade wood, very suitable for interior trim. It is light, straight grained, easily worked and takes a beautiful finish.

British Columbia red cedar beams are used for the ceiling of the dining room with admirable effect. It shows that red cedar beamed effects are suitable not only for such as the much admired Music Room at Hart House, University of Toronto, but that this wood is also effective in beautifying the rooms of moderately priced homes. The ceiling is panelled with three-ply cotton wood veneer in a smooth satin, maple finish. Edge grain Western larch is used for flooring in this room.

Cottonwood panels have been little used in the East as yet for panelling, but their cheapness, quickness of application and ease in finishing to any desired effect will soon make them very popular for panelling halls, dens and dining rooms.

The dining room may be truly said to be highly successful in design and general effectiveness, and there is no doubt but that the woods shown will be used largely by future homebuilders now that they can see the splendid effects obtainable with them.

The outer walls of this "house within a house" as it has been called, shows the beautiful effect obtained by the use of British Columbia red cedar shingles. The twenty-four inch Royal grade was used. These shingles have substantial butts one half inch in thickness. They were first treated by being dipped in a Dixie white paint and then laid on the wall with a ten and one half inch exposure to the weather. Afterwards, they were given two coats of Dirie white which gives a splendid effect.

Exterior window and panelling in Western hemlock

Thatched Roof Effect in Shingles

The roof portion is of XXXXX B. C. red cedar shingles with some of them bent to give thatched roof effect. They were laid with an irregular wavy exposure to the weather. Before laying they were Creo-Dipped in shades of green, red and brown. This gives a pleasing effect when they are laid in alternate colors. As this is one of the first examples of thatched roof effects in shingles to appear in Toronto, it is causing a great deal of interest and favorable comment.

Hot-dipped, zinc-coated cut nails were used throughout for laying the shingles. This was done with the hope of influencing architects, contractors and homebuilders to use first class shingle nails. Too often it has been found that the ordinary wire shingle nail does not give a service nearly equal to the life of the shingles. In this connection it may be noted that already a large number of progressive retail lumbermen are carrying a zinc-coated shingle nail which gives excellent results at a very small additional cost, indeed, so small as to be negligible when the additional life of the roof is considered.

Western white pine was used for the exterior finish and proved itself highly adaptable to the somewhat delicate detail required for trim around the main entrance door.

The rooms are completely furnished with Canadian made furniture and all lighting fixtures are installed as they might be in any home of good taste.

The cumulative effect of the whole has resulted in an exhibit which will have a great educational effect on Ontario homebuilders in the use of good Canadian grown woods for Canadian homes.

It is also hoped that this exhibit will be of great service to woodworkers and manufacturers of interior trim, by showing the powerful effect of such a finished exhibit as an advertising and selling force. The propaganda of the manufacturers of substitutes must in time have a serious effect on the lumber, and mill business in general unless counteracted, and it would seem that there is no better way to sell wood products than by showing the people what can be done with wood. Finished rooms or suites as that now completed for the British Columbia forest industries comprise a splendid way of convincing even the most exacting homebuilder just what can be done with native grown lumber.

Grading of B. C. Woods

Another exhibit now under way at the same address as the exhibit just described is a "Grading Exhibit of British Columbia Woods." At the present time very few architects or engineers clearly specify lumber according to actual grades and many are the misunderstandings and disputes which arise from this incomplete method of specifying. In order to overcome this and to show the actual grading of British Columbia woods, it is proposed to place on exhibit several pieces of each grade manufactured. Different sizes will be shown framed in convenient display racks. All pieces will be about ten feet in length, so that an excellent idea of grades can be obtained by the architect or engineer before specifying.

The same will apply to shingles, for market extension men have found that there is room for considerable educational work amongst architects in the right specifying of shingles. Few of them are aware that there are other grades than XX and XXX red cedar shingles and they are always astonished and pleased when shown XXXXX, Perfections and Royals as manufactured in British Columbia. In this exhibit all grades will be shown which will be of great help to architects and homebuilders in solving the important problem of a durable roof.

Built-in china cabinet and panelling in Western hemlock

The old time, easy methods of taking orders for lumber have had to bow to inevitable progress, and clean cut selling methods, backed by service, are now recognized as necessary by all millmen. In this connection display of woods embodied in the structural and finished portions of life-size rooms should prove weighty factors in the distribution of good wood. The keen interest already shown in the pioneer built-in exhibit of the British Columbia forestry service bears this out to the letter. Just as architects and homebuilders have always studied the finished effect of the past domestic architecture of all ages in search of the beautiful for their own creations, even so will they study with satisfaction the finished design as shown in room and suite exhibits. When they are interested to the point of desire they are more than half sold.

Compressed Air Sickness

Investigations by the Bureau of Mines—The Provision of Medical Air Locks is Most Effective Remedy

The article in the "Contract Record" of August 16, page 816, by W. G. Cameron, entitled " Regulations Needed to Reduce the Compressed Air Hazard" drew attention to the investigation of the Bureau of Mines, Washington, D.C., under Dr. Edward Levy. His report which has just been issued brings together the experience with compressed-air sickness obtained in the work of driving the Public Service Commission's rapid transit tunnels under the East River at New York within the past half dozen years, and presents a number of conclusions differing from those previously accepted, or confirming prior views with better evidence. The total number of decompressions for these tunnels was 1,361,461, in which occurred 680 cases of compressed-air sickness. Data from the driving of the Pennsylvania East River tunnels, with 557,000 decompressions and 3,692 cases of sickness, are also taken into account after a report published by Dr. F. L. Keays in 1909.

The following review of the report is given in Engineering News-Record.

Physical perfection in the worker is concluded to be less important than was formerly believed, on the basis of experience with mediocre workers during the war; the essentials are normal lungs, normal kidneys, and a good heart, and in older men a blood pressure not too high. Data on the influence of age are uncertain, but 87 men known to be over fifty years old developed only three cases of sickness, indicating that "in selected men advanced age may not be such an important factor as many writers insist." Obesity is not found to be an important factor; Dr. Levy says that "Men with a moderately-increased amount of adipose tissue are not more susceptible to compressed-air illness than is the average individual," and in consequence "he is less inclined than are some others, to enforce strictly a rule that no man with a tendency to fatness be employed." The outside temperature does not appear to be a factor in the incidence of compressed-air sickness, nor was humidity found to have any distinct effect.

As to the effect of pressure, it is noted that all of this work proceeded under the New York State law, which limits the working hours to eight (in two periods) for pressures up to 22 lb., two 3-hr. periods with a rest interval of 3 hr. for pressures from 22 to 29 lb. inclusive, two 2-hr. periods with a rest interval of 2-hr. for pressures from 30 to 34 lb. inclusive, two 1½-hr. periods with a 3-hr. rest interval for pressures from 25 to 39 lb. inclusive, two 1-hr. periods with a rest interval of 4-hr. for pressures from 40 to 44 lb. inclusive, and two 3/4-hr. periods with a rest interval of 5-hr. for pressures from 45 to 50 lb. inclusive.

Dr. Levy agrees with earlier investigations that the saturation of the tissues of the body with nitrogen is the cause of the compressed-air sickness. Carbon dioxide was not found to have any effect, within the close limits of control maintained on the Public Service Commission work, where the partial pressure of carbon dioxide reached 1 per cent. only on two or three occasions. The symptoms in 92 per cent of the cases were localized pain in the body (chiefly pain in the joints), vertigo in 6½ per cent., and affections of the central nervous systems (numbness, paralysis, etc.) in 1.6 per cent. Two deaths occurred, from choking and collapse respectively. These distribution percentages agree very closely with corresponding ones for the Pennsylvania tunnel work. The disease showed itself within the first hour after decompression in 64 per cent. of the cases (86% on Pennsylvania work), and no case developed after 18 hr. (23 hr.).

Treatment of compressed-air sickness, according to Dr. Levy, is most effectively conducted by providing medical air locks and arranging to have all the workers who may be taken sick, whether on or off duty, brought to the medical lock for recompression. He advises ample time of recompression, particularly in the more severe cases. Among his other suggestions are that decompression by the stage method should be based on an initial drop of pressure to not less than half the gauge pressure (instead of half the absolute pressure), that chilling due to the cooling in recompression be avoided, that changing of men from one shift to another be avoided as tending to disturb living conditions and likely to induce anemia, and that the limits of working hours based on pressure be changed by lowering the upper limit of each class, so that, for example, the length of working period for pressures of 29 lb. and 34 lb. would be reduced.

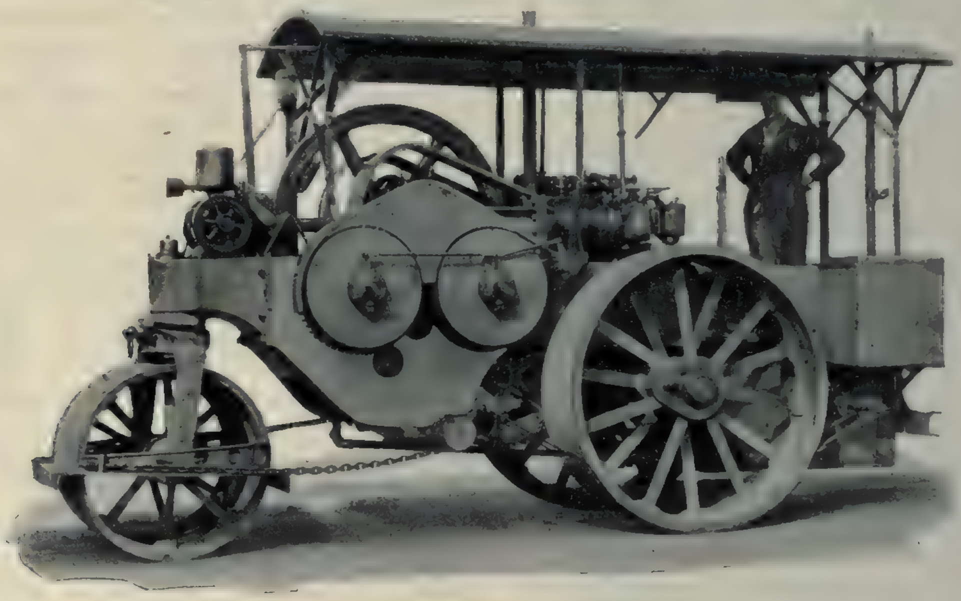
Messrs. Compton & Co. Ltd., Chelmsford, England' have published a handbook entitled "Experiments With The Slide Wire Bridge." It is written by Mr. David Robertson, D. Sc., M.I.E.E., Professor of electrical Engineering in the University of Bristol, and is specially designed for use in the electrical laboratory. Price, three shillings net.

DeWind-Inglis Road Roller

One of the most interesting exhibits at the Canadian National Fair this year is the new DeWind-Inglis road roller. This is the first gasoline operated roller to be manufactured in Canada, though a limited number have been imported from the United States, and used chiefly in Western and Eastern Canada. This new roller will be manufactured in Toronto, by the John Inglis Co., Ltd.

A number of advantages are claimed for the gasoline operated roller. It will operate equally well on kerosene. It will carry enough fuel to operate it for three weeks or a month continually. It has been designed by Mr. N. DeWind, who as long ago as 1903 designed the DeWind-Allen roller, which was later built by Messrs. J. G. Allen & Co., of Comber, near Belfast, Ireland, and, who a few years later, designed the first motor roller ever built in the United States.

In all his former designs Mr. DeWind has been under the necessity of designing a chassis to fit a stock gasoline engine, or to fit a stock engine into a stock chassis, but in the present Canadian design he had a free hand in both the design of the engine and the roller proper. For this reason he has been enabled to incorporate the best practice in both engine and roller, and the opinions of road builders at the Fair, which have been freely expressed, indicate that this Canadian-made motor roller is the best of its type that has been turned out. A U. S. highway engineer visiting the Fair this year gives it as his opinion that at least 50 per cent. of the rollers now being purchased in the United States are motor driven.



Another feature that is well worthy of mention, in this northern climate, is the water circulation system. Water is circulated from the tank through the jackets by a pump. The jackets drain themselves when the engine is shut down, so that all danger of frost is removed. As soon as the engine starts, the pump again brings the water from the tank into circulation. A further feature that practical roller men will appreciate, is that the bearings of the rear axle and pinion shaft are so constructed that either shaft or axle can be dropped down and taken out without removing any of the parts mounted on them. A view of the new roller is shown.

Concrete Basements and Foundations

Instructions Issued by the Portland Cement Association Concerning the Use of Monolithic Concrete or Concrete Blocks for Foundation Walls—Ensuring Watertightness

Concrete foundation and basement walls are of two types, those made of concrete cast in place and those built of precast units, such as concrete block. Both types have proved satisfactory. Concrete block walls are usually less expensive than solid concrete walls, but where loads are very heavy or where there is a severe side thrust of soil as in deep cellars or hillside locations solid concrete walls are usually preferable. Where unusual strength is required steel reinforcement and concrete pilasters or buttresses are easily added.

Designing the Foundation Wall and Footing

Concrete foundation walls and footings must have sufficient strength to support the weight of the building safely and without settlement. When the foundation serves as a basement wall it must have strength to withstand the lateral pressure of the soil and also must be watertight.

For all types of buildings it is essential to extend the foundation below possible frost penetration even though firm bearing soil is found at a shallower depth. Then the foundation will not be upheaved by freezing. The depth to which frost penetrates varies and may be as much as 6 feet in sections where winters are severe.

The base of the foundation is usually given a "spread" or "footing" to distribute the weight of the building over a larger area than covered by the area of the base of the walls. In determining the width of footings the character of the soil, as well as the weight of the structure, must be taken into account as the load bearing capacity of different soils varies.

The following table indicates the safe loads for various soils:

Soft clay	1 ton per square foot
Wet sand	2 tons per square foot
Firm clay	2 tons per square foot
Fine and dry sand	3 tons per square foot
Hard dry clay	4 tons per square foot
Coarse sand	4 tons per square foot
Gravel	6 tons per square foot

To calculate the proper width of footing, it is necessary to estimate the load to be carried (the weight of the building and contents) and to ascertain or make reasonable assumption of the bearing power of the soil where the building is to be located.

Under the basement walls of a barn, a concrete footing 2 feet wide and 12 inches deep will usually be sufficient. Small residences generally require footings 18 inches wide and 12 inches deep. Footings 12 inches wide and 8 inches thick will serve for farm buildings such as hoghouses, poultry houses, milkhouses and buildings of that size.

A foundation wall 8 to 12 inches thick is generally ample for small structures not more than two stories high. Basement walls for residences are also made from 8 to 12 inches thick. Small structures, such as poultry houses, milkhouses and garages, require foundation walls from 6 to 8 inches thick.

The following table gives the thicknesses of basement walls and upper story walls of residences and apartment buildings recommended in the American Concrete Institute Specifications for Concrete Building Block, Brick and Tile:

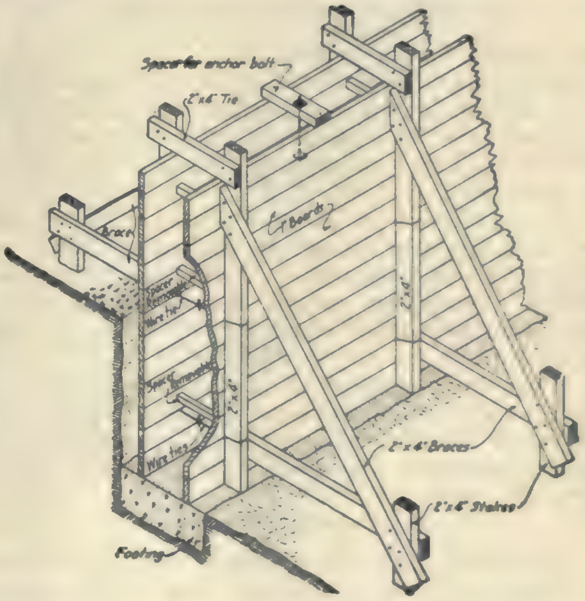
No. of stories	Basement inches	1st story inches	2nd story inches	3rd story inches	4th story inches
1	8	8	—	—	—
2	10	8	8	—	—
3	12	12	10	8	—
4	16	12	12	10	8

Concrete Footings

The usual practice is to lay monolithic concrete footings for all types of foundation walls. They are easy to build and insure uniform distribution of the weight of the building on the soil. They provide an even surface on which to start laying the wall proper whether block or monolithic.

Monolithic Foundations

In building foundations for small structures without basements, the earth walls of the foundation trench may be so firm as to make it unnecessary to use specially built forms for that part of the wall below grade. The trench should be excavated carefully so that the sides will be even and vertical, and care should be taken not to knock earth into the trench when depositing or spading concrete. Planks placed alongside the trench, will help to protect the edges and provide a convenient runway for wheelbarrows. In soft ground and for walls above ground level, forms are required.

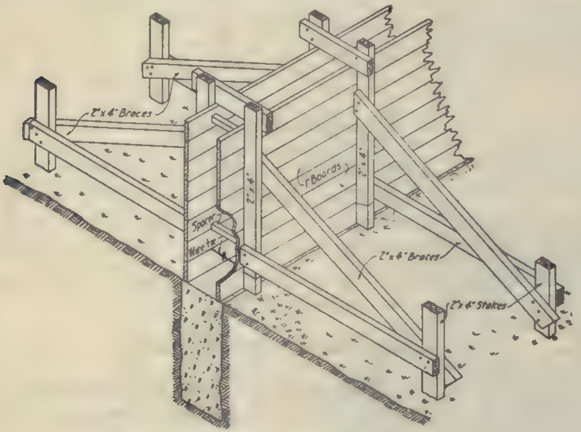


Forms for foundation walls

Forms

Well seasoned, air dried lumber is best, as green lumber will shrink if not kept wet, thus opening cracks in the forms through which water carrying cement will leak when the concrete is placed. It is best to use lumber that has been dressed at least on one side and on the edges, because the boards will fit closely together and the planed surface next to the concrete will reduce the labor of removing and cleaning forms. Tongued and grooved lumber is often used for form sheathing, and is recommended for tight forms. Form lumber should be uniform in thickness, as any inequalities of thickness cause unevenness on the concrete surface.

Posts and studs for supporting forms must be sufficiently stiff and strong to hold forms in true line. Forms should always be rigid and well braced in order to withstand the pressure of wet concrete and produce a straight, even wall without bulges or depressions. For keeping inside form surfaces the proper distance apart, inner and outer sections should be clamped or wired together, against wood "spacers" or "spreaders" of a length equal to the desired wall thickness. The spreaders are removed as the forms are filled with concrete.



Forms for foundation wall above grade

Forms should be so built that if it is desired to use them again or to use the lumber for other work, they can be "knocked down" with least injury to the lumber. Screws or special double headed nails are often used instead of common wire nails for making forms.

To prevent concrete from sticking to the forms and to aid in their removal, crude oil, soft soap or whitewash should be painted on the forms before placing concrete, this being repeated each time the forms are used.

Retaining Walls

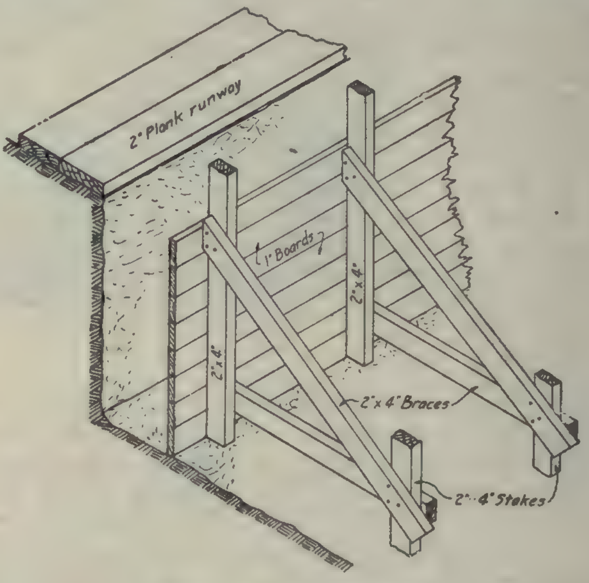
Foundations for deep cellars and basements for buildings on sidehill locations must often withstand a heavy pressure from the soil. These foundations are then designed as retaining walls. They require careful design, and if the builder is not familiar with the principles of retaining wall design, he should consult a competent structural engineer. Basement walls of large barns are often designed as retaining walls. For most residences and farm buildings the ordinary basement walls have sufficient strength to withstand soil pressure.

Concrete Mixtures

If the foundation is located in soil that is not well drained and is to form part of the enclosure of the basement or cellar, a 1:2:3 mixture (1 part cement, 2 parts sand and 3 parts pebbles or broken stone) is recommended for such work to insure watertight construction. For most foundation work a 1:2½:4 and in some cases a 1:2½:5 mixture will be found satisfactory. Sand should be clean and well graded in size up to one-fourth inch. Pebbles or crushed stone should also be clean, hard and well graded, ranging in size from one-fourth inch up to 1½ inches or more, depending on the thickness of the foundation wall.

Use only enough water to produce, after thorough mixing, a plastic workable mixture. Too much water produces a sloppy mixture, resulting in a concrete of inferior strength and too little water results in a porous concrete also deficient in strength. From 6 to 7 gallons of water per sack of cement will usually produce about the right consistency for a 1:2½:4 concrete.

Concrete should be placed in the forms in layers of from 6 to not more than 10 inches deep and in a continuous operation if possible to avoid construction seams. Concrete of the consistency described above will require only light tamping but should be well spaded next to form faces to obtain smooth, even surfaces. It is well to complete a foundation or wall in one day's operation if possible so as to avoid construction seams. If it is necessary to stop work before a wall can be finished the concrete should be leveled in the forms and the surface roughened by scratching it or by placing large pebbles in it projecting about half way out of the concrete. This will help to secure a good bond between old and new layers of concrete when work is resumed. Before depositing an additional layer of concrete the roughened surface of old concrete should be scrubbed to remove any dirt or scum and, just before placing new concrete, it should be painted with cement and water mixed to the consistency of thick cream.



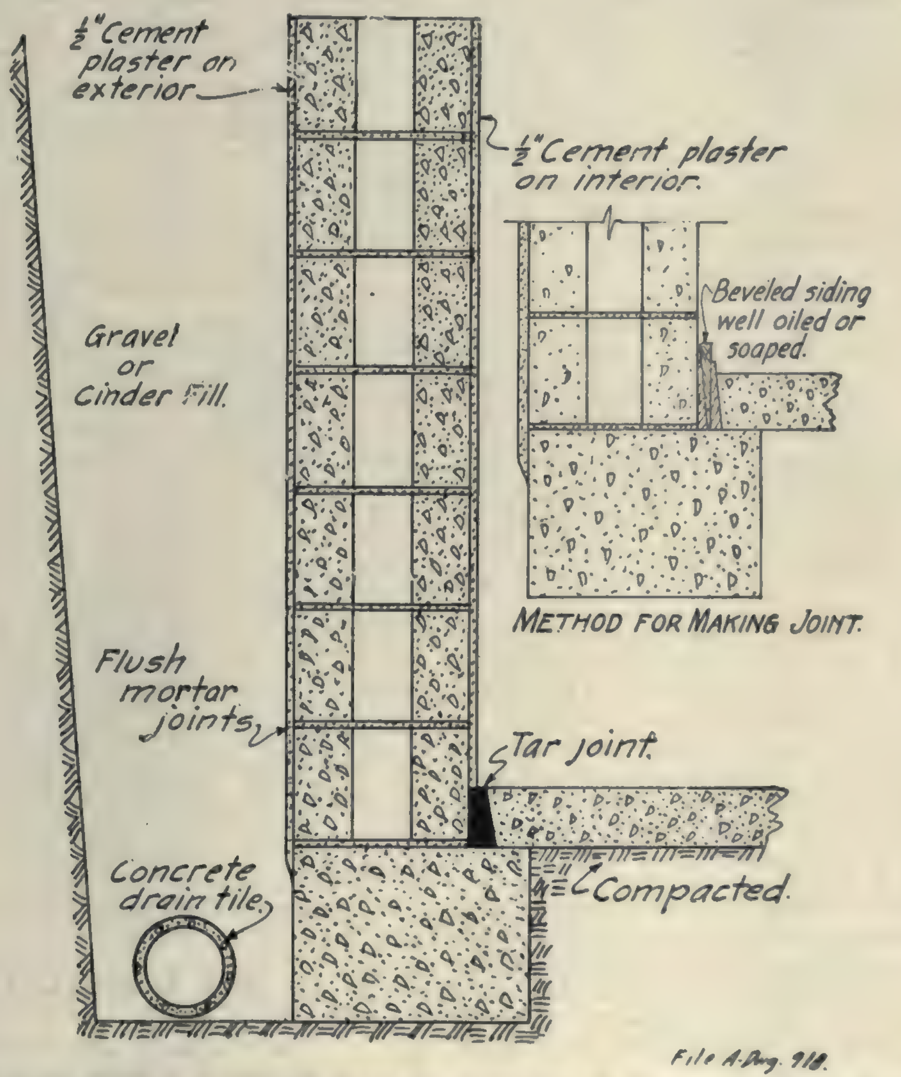
Forms for foundation walls

Frozen Concrete

Concrete may be placed safely even in cold weather if water, sand and stone are heated and the finished work is protected from frost. Heat hastens and cold delays the hardening of concrete. Under conditions favorable for hardening, concrete soon acquires sufficient strength to be safe against damage by frost. The warmer it is kept the sooner will it reach this degree of hardness. Concrete which has frozen before it has thoroughly hardened is often mistaken for properly hardened concrete but when it thaws it will soften.

Reinforcement in Foundation Walls

If the wall is to carry extremely heavy loads or is to be subjected to excessive side pressure, vibration or unusual strains, steel reinforcement must be used. Reinforcement is also used in walls above ground to counteract expansion and contraction caused by temperature changes. Reinforcing rods are also required over door and window openings. The size and number of rods will be governed by the width of the openings and weight of the super-structure. The design of reinforcement involves the application of engineering principles and is best done by an experienced engineer.



Typical method of building basement in wet soils. Note the tar joint between wall and paving, and the drain tile below floor level

Concrete Block Basement Walls

Concrete block are now in common use for the construction of basement walls. They may be laid quickly and economically because the units are relatively large, and uniform in shape. No forms are required. The air spaces in the block help to provide a dry, well insulated wall as well as effect a saving in concrete and make the units lighter and easier to handle.

Concrete block used in basement construction should have great compressive strength or carrying capacity. The block should develop an average ultimate compressive strength of 1,000 pounds per square inch over the gross area of the block when 28 days old.

For the foundation wall below grade, smooth faced unsurfaced block are used. Unsurfaced block are also used above grade also when the wall is to be stuccoed. Block having smooth faces or special facings of selected aggregate are recommended if stucco is not to be applied.

Care is needed when laying concrete block to secure a strong, watertight wall. Mortar for laying block is usually mixed in the proportion of 1 sack of Portland cement to 2 cubic feet of sand. The sand should be clean and well graded. By "well graded" is meant that the particles should not be all fine nor all coarse but should be made up of fine, intermediate and coarse particles. Sand should pass through a screen having meshes ¼ inch square. Mix only enough mortar at one time for 30 minutes' work. Retempered mortar should not be used as its strength will be reduced.

Before the block are laid they should be moistened with water so that they will not absorb too much water from the mortar, thus reducing its strength.

In first class masonry work joints are usually made from one-fourth to three-eighths inch thick. All joints should be well fitted with mortar and carefully pointed. Joints on the outside wall below grade should be struck flush with the wall surface.

Constructing a Watertight Basement

The time to make a basement wall watertight is when it is built. It costs less to build a watertight wall than to repair a leaky one later. If properly made, a concrete wall is watertight. The aggregates must be carefully graded and properly proportioned with the correct amount of cement and water and then mixed and placed as previously described. However, it is not always easy to get first class workmanship and when the foundation is located in heavy water-logged soils, water may find its way through construction seams. To allow for the possibility of defective workmanship, it is well to use the additional precautions shown in one of the sketches. Similar methods are used for repairing leaky basements and for insuring watertightness in basements built of concrete block or concrete structural tile.

In each case a line of concrete drain tile is placed entirely around the outside of the footing and is connected to a suitable outlet. The excavation above the tile is filled to within a foot of the grade line with gravel, cinders or some other material of a porous nature to provide a fill that will allow water to seep through quickly. When the foundation is erected so near another building that it is impossible to run a line of tile around the outside, the tile may be placed on the inside of the footing and slightly below it. When there is considerable water in the soil it is often advisable to place lines of tile both inside and outside of footings.

As a further precaution in securing a dry basement, two or more coats of cement plaster mixed in the proportion of 1 sack of Portland cement to 2 cubic feet of clean, well graded sand may be applied to the exterior surface as soon as wall forms are removed or in the case of a concrete block wall just as soon as the mortar joints have hardened. The wall surface should first be thoroughly dampened. A similar coat of cement plaster may be placed on the inside surface if desired.

Another common method of wall treatment is to coat the exterior surface with hot tar, pitch or some other suitable asphaltic preparation using a broom or fiber brush. The wall must be clean and dry when this coating is applied, otherwise it will not adhere. The plaster treatment is generally the most satisfactory method.

Basement Floors

A concrete basement floor should be at least 4 inches thick. It may be of two-course construction using a base of 1:2½:4 concrete and a three-fourths inch top coat of 1:2 cement sand mortar or it may be of one-course construction using a 1:2:3 concrete throughout. In the latter case mortar is brought to the surface by careful tamping and a dense, even surface is produced by finishing with a wood float. A little 1:2 mortar may be used in finishing if needed. In general the one-course construction method is satisfactory.

If the soil is water-logged, special care should be taken to make a tight joint between the floor and the wall in the manner shown in the cut. Strips of bevelled siding well oiled or soaped are placed against the walls in the manner indicated. These are taken out just as soon as concrete has hardened sufficiently to stand by itself. This can usually be done within a few hours after concrete is placed. The joint is poured full of hot tar later, the tar being calked or rammed home.

Where the situation of the basement is such that the ground water level is likely to rise above the floor level, further precautions should be taken to prevent leakage since the construction becomes similar to the building of a tank, except that external and not internal pressure must be provided against. It may be necessary to make the walls thicker and to place reinforcement in the walls and floor. Such cases require special design for walls and floor and this should be made by an experienced structural engineer.

Attaching Sills and Plates to Concrete Walls

Sills and plates of frame structure should be bolted down to concrete walls. The anchor bolts should be imbedded in the concrete,, the anchor bolt being supported by a block laid across the form while concrete is being placed.

Setting Door and Window Frames

Frames for doors and windows may be set before the walls are built or they may be inserted after walls are completed. In the first case the frames are carefully set in proper place in the forms before concrete is placed. Spikes are partly driven into backs of frames so that when concrete is placed they will be securely tied to the wall. When frames are set after wall is built rough "bucks" must be set in forms to provide the required openings. Nailing blocks are lightly tacked to the backs of the bucks. When concrete has hardened the bucks are removed, leaving the nailing blocks firmly imbedded in the concrete with one surface exposed. The frames are then set and nailed to the blocks. The first method is the simpler and insures the tighter joint, and is generally used in all except the highest class of construction.

In constructing concrete block walls, the frames are usually set and built in place when the block are laid. The frames may be anchored to the wall by driving spikes partly into back of frames at mortar joints.

The Materials Market

The anticipated advance in the retail price of steel took place last week in the following lines: Mild bars, ¼ in. and heavier went from $3.25 to $3.50 per 100 lbs.; bands, 3/16 and lighter, from $3.75 to $4.00; twisted and deformed bars, from $3.00 to $3.35; angles, channels and tees, under 3 in., from $3.25 to $3.60; galvanized sheets, 28 gauge, from $6.00 to $6.20 and galvanized corrugated sheets, 28 gauge, from $6.00 to $6.20. The only other movement noted in the building supplies market in this district was a drop in raw and boiled linseed oils, the former coming from $1.20 to $1.10 per gal. and the latter from $1.23 to $1.13.

Where Paper Profits in Highway Construction Disappear

The Uncertain Factors That Eat up Money and Leave the Contractors at a Loss—Costs Vary Widely and Lost Time and Weather Delays Make Profits Doubtful

In the "Contract Record" of February 8, 1922, page 130, an article on the above topic by H. H. Wilson, threw some light on the factors that cause supposed profits to turn into losses and emphasized the need of careful study and experience to minimize the uncertainties of contracting. Another analysis of this important subject by a successful highway contractor is contained in the current issue of "The Constructor," the official publication of the Associated General Contractors of America. The author is W. F. Creighton, of Foster and Creighton Co., Nashville, Tenn. His comments follow:

It is presupposed that the contractor is "from Missouri" when preparing his bids, and has given them the intelligence and diligence he expects to put forth in executing the work, if successful, and that all known items of overhead (such as officers' salaries, interest on retained percentages and invested capital, bond, cost of preparing estimates, field and main office expense, taxes) and that all direct charges (such as freight, setting up and moving plant, depreciation, depletion, repairs and storage on all equipment, public and employees' liability insurance, camp site rental, small tools, etc.) have been included as cost before profit is added. Incidentally, W. O. Winston, past president of the Associated General Contractors, and dean of successful engineering contractors, when asked how much profit should be added, replied: "If you are sure of your cost, add ten per cent for contingencies and ten per cent for profit." Repeating that, with the assumption that these items have been included as cost and the desired profit added, the object here will be to show why this paper profit is seldom realized.

Causes for Losses

First. Most contracts prepared by engineers are one sided, and, with few exceptions, the interpretation by the author results in loss to the contractor.

Second. There is a tendency among resident engineers to underestimate work done each month, which largely increases the interest on capital needed to carry the job.

Third. The growth of automobile traffic and the consequent injury to highways has been so rapid that engineering practice has not agreed on the best type of roads and methods of construction; consequently, there is no authority to guide inspectors; therefore, each acts from an independent viewpoint, with the result that methods learned under one engineer's supervision will not satisfy another.

Fourth. Contractors are necessarily of an optimistic disposition and are inclined to take their cost data from a few days of good work on a previous job rather than from an average yearly cost, and the principal reason for disappointment is this tendency. To particularize:

Costs of Excavation

The first item of building a highway is, of course the excavation. In many places this includes clearing and grubbing, removing structures (which may be a fine residence), fences, telephone poles, etc. While it is seldom done carefully, the cost of these items may be estimated with reasonable accuracy; but most contractors, basing their cost data from experience gained in railroad grading, overlook them and also fail to realize that the small amount of material to be handled per mile, the accuracy of the surface required, the necessity for thoroughly compacting the embankment, the cost of preparing shoulders after the surface is applied—months later, when rains may have washed away much of the material intended for that use—make highway grading an entirely different and vastly more expensive problem than railroad grading, but with the same risk of finding good or bad material. Grading costs often vary 100 per cent. to 200 per cent. above a carefully prepared estimate. Thomas H. McDonald, chief of the United States Bureau of Public Roads after an analysis of excavation costs over the entire country, says: "The man who attempts to forecast the cost of excavation from a knowledge of previous cost, is a most intrepid individual."

Difficulties of Surfacing

Then the surfacing—if done with gravel, and the contractor is paid by the cubic yard, loose or by weight, the problem is simply one of locating suitable pits, selecting efficient loading and transporting equipment, allowing for bad days and breaks-down of equipment, spreading and rolling. But where he is paid for a certain thickness after compacting, he faces the impossible task of estimating the amount of loose material required, because different materials compress to a different extent, some requiring 25 per cent excess, others 50 per cent. The same uncertainty applies to the application of crushed stone and in all classes of highway construction the quantities handled are so large, that a very slight error in judgment runs up into a large total.

With hand placed base, added difficulties are encountered, as the location and operation of stone quarries are necessary. This is similar to any other operation, and it is well known that mining is a hazardous industry; even in gold mines, it is estimated that more money has been sunk into them than has been taken out. The quarries should be located within a reasonable distance of the road and at the proper distance apart, with light over burden; the stone should be suitable and easily worked; semi-skilled labor is required and efficient equipment necessary. No experience can positively locate a quarry answering the above requirements; and it is frequently found that stone passing the French coefficient test will disintegrate after a few months in the weather, other stone that will pass the test cannot be drilled or sledged, suitable stone, located in one part of the quarry, may entirely dissapear on account of a geological fault and the remainder be worthless; these conditions may easily cause a variation in cost of 100 per cent., which on ten miles of penetration road with stone base may amount to $20,000.

Where the material is delivered on cars the chief cause of uncertainty and consequent loss is due to shortage of railroad equipment, indifferent service by the railroads in handling a commodity at a low freight rate, and the cost of well located team tracks.

Loss of Time

The above may easily use up Mr. Winston's 10 per cent. for contingencies, but there is another cause affecting highway work more than any other, and that is the cost due to lost time on account of bad weather, where the material must be hauled over soft roads. After every shower for several days the roads are too soft for trucks or too slick for the roller, and in cold weather asphalt and concrete cannot be placed. On such a contract we only worked 87 days between July 4 and December 31, 1921, while on a similar job over hard roads, during the same period, we worked 142 days. The State Highway Department of Iowa reports that an average of 31 contractors in their State could have completed the 1921 season's work in 143-3/10 calendar days had there been no delay.

Rental Charges for Equipment

Consider the waste and how the profits disappear when a contractor estimates his rental cost on a use of 250 days in the year and only gets 114.

For example, a properly equipped and well-organizen road job, ten miles long surfaced with an eight-inch modified Telford base and a two and one-half inch asphatlt penetration coat costing $200,000 will require one year for the grading and one year for the surfacing. The equipment for the grading will be fifty mules, six dump carts, ten dump wagons, sixteen wheel scrapers, five drag scrapers, one stump puller and one pumping outfit. The daily rental of this outfit, according to the rental schedule prepared by the Associated General Contractors, considering the live stock at $1 per head, will be $58; the time of the superintendent, timekeeper and steady-pay men will be $23 per day; the overhead will be not less than $4 per day, making a total of $82 for each day, including Sunday, that the equipment is idle.

For the base and surface there will be required two tractors, two graders, three 10-ton rollers, two portable crushing outfits, four quarry outfits, one oil distributor (with tank and boiler), eight 3½-ton trucks, one 1-ton truck, one passenger car. The rental of this will amount to $60 per calendar day. Adding for the steady-pay men $23 per day and $12 for overhead, makes a total of $95 per day; therefore, if only 180 days are worked on the grading in a year the contractor's loss is $15,150. If only 150 days are worked on the surface the contractor's loss is $20,425, which is 17½ per cent. of the total cost of a job of this size.

The last item is undoubtedly the largest cause of loss, and like the other causes, it can be determined only from records carefully kept on previous jobs. Paper profit will not stay at home until bids are made from data obtained from an entire year's performance, eliminating the false hope that weather or other adverse conditions will change.

Exhibits of Interest to Contractors at the Canadian National Exhibition

The Canadian Municipal Equipment Corporation had an outdoor display just inside the eastern entrance to the grounds and showed their Otterson Auto-Eductor, which is an equipment for cleaning catch basins, mounted on five-ton truck chassis, and also their Otterson Auto Ash Conveyor, an end-dump truck equipped with bucket elevator on the side, which is operated by a hand lever. Representatives were on hand at all times to explain the working of these units and interesting literature was distributed.

* * *

At the motor truck display, which occupied its new location in the big new Coliseum Building, several manufacturers showed end and side dump trucks for material hauling, etc., nearly all of which were of the heavy duty type. The various makes noticed were the Gotfredson, Gary, Commercial, which is a three-way dump, to either side and back, the White, Mack, Lenglen and Packard.

* * *

In the west annex of this building the Ontario Safety League had a safety exhibit covering considerable space, where they showed wrecked automobiles, resulting from accidents due to carelessness, the history of each accident being printed on large cards displayed in front of each exhibit. These were very striking and impressive pleas for safe driving. Another feature of the exhibit was a section of a passenger car, installed by the Toronto Transportation Commission, to demonstrate safety in connection with street car traffic. Exhibitions of resuscitation from drowning were given by boy scouts at the exhibit throughout the two weeks of the fair.

* * *

At the Ontario Department of Highways' bungalow, west end of the grounds, several miniature models of various types of roadways were shown and maps of provincial highway routes were distributed free.

* * *

In the Government Building was an excellent display of British Columbia woods, in finished and unfinished states. All the furnishings of the showrooms, in fact the rooms themselves, were constructed and trimmed with British Columbia wood products. A dining room, 11 x 14 feet fitted up at one end of the display space, was finished on the outside with Royal shingles. The flooring of the room was of edge grain hemlock and the walls were made of cottonwood panels with Western hemlock stiles and rails. The finish was of weathered oak and the whole effect was very striking. The ceiling was of cottonwood panels, stained pearl grey, with Douglas fir beamed ceiling effect.

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The office in connection with the Ontario Department of Mines was very attractively constructed in varied colored marbles from the quarries of Bancroft Marbles, Ltd.

* * *

The Booth-Coulter Copper & Brass Company, of Toronto, displayed their extensive line of copper and brass goods at their large booth in the Process Building, featuring their "Imperial" art brassware.

* * *

The many products of wire and steel, manufactured by the Wallace Barnes Company, of Hamlton, were attractively displayed at their booth in the Process Building.

* * *

The large exhibit of the A. R. Williams Company, in Machinery Hall, was a busy spot throughout the entire fair, the extensive line of machinery displayed here holding interest for a large percentage of the thousands of visitors to this building. The display included portable electric tools, engines, air compressors and many other, too numerous to mention here.

* * *

The Clay Products Agency of Canada, Ltd., at their tent on the grounds, showed their entire line of sewer pipe, fire brick, and other articles in clay. Outside the tent was constructed a short half section of segment block sewer, 48 inches in diameter. The exhibit was in charge of Mr. Wallace, manager of the company.

* * *

The Laidlaw Lumber Company's exhibit in the Industrial Building is one of the largest in the building and faces on two aisles. It comprises the company's entire line of woods and wood products and presents a very imposing and attractive appearance, the entire trim and flooring being of highly polished hardwood.

* * *

Brass valves are featured in the display of the James Morrison Brass Manufacturing Company, in the Industrial Building. Their large space, however, is ample to show their entire line of plumbing, heating, water fittings, etc.

* * *

Crane Limited also occupy considerable space in the Industrial Building and are showing their extensive line of valves and fittings, plumbing and heating supplies.

* * *

The Imperial Oil Company's building is, as usual, a very busy spot, the extensive line of goods handled by this company holding interest for a large percentage of the visitors to the Fair. A large staff of the company's representatives are on hand at all times.

Plans are under way, which it is hoped, will result in the construction of two new buildings at the Canadian National Exhibition grounds, Toronto, for the Fair of 1923. One of the buildings will be for the housing of the exhibits of the textile trades, which at present have no building exclusively their own. The other will be for the display of machinery, and is expected to be up-to-date in every particular, with big cranes to handle heavy machinery, etc., and all other accessories needed.

The Cement Gun in Water Works Practice

By L. R. Talbot.

In the past eight or ten years the cement gun has become closely identified with the water works business. During that period a large number of reservoirs have been built or repaired by the use of the cement gun. There is hardly a state in the country which has not within it an example of the successful application of this method. The territory represented by the members of this Section can offer a large number of such illustrations, while Muscatine, Iowa, holds the distinction of being the first city to have had a reservoir lined in this manner.

For this reason, it is a pleasure to describe to you briefly the elements of this process and to point out a few of the many instances of its application.

Method of Application

"Gunite" is the cement and sand product of the cement gun. This material has been successful in this kind of work because, when properly placed, it makes a water-tight job, which will not crack or check when properly reinforced. As it is placed with an air pressure of from 30 to 40 pounds per square inch, it is driven into the surface and forms a coating that is 40 per cent more dense than hand or machine mixed mortar. In other words, the same amount of dry material when deposited by the gun would require only 60 per cent as much volume as the same amount placed by hand. Because of this density, its strength is over twice that of ordinary concrete.

The material may be placed at a considerable distance from the gun, thus obviating the necessity of an extensive handling plant. A thin coating may be applied without the use of forms or other preparatory work, except cleaning the surface and applying the reinforcing, both of which must be done in any case.

The gun is adaptable for building new reservoirs which are above ground, as well as lining the excavated type. Seven years ago, a reservoir was built at Elmhurst, New York, without the use of forms of any kind. The reinforcing was erected and a light frame used as a backing until enough material had been deposited to support itself, when the frame was moved ahead. A better scheme than this was used at Ford-City, Pennsylvania, last year, where a circular reservoir 110 feet in diameter and 17 feet deep was constructed of "Gunite." The only poured work was that for an annular footing slab under the wall. Vertical reinforcing consisted of one inch square rods and horizontal reinforcing was one inch twisted bars, spaced according to pressure requirements Two layers of mesh reinforcings were used. The reinforcing was erected entirely and tied together, then a light wood form or backing was built on the outside and against the steel. Mesh was applied to the inside and the inside was "shot." The forms were then removed and another layer of mesh applied to the outside and the outside was shot, bringing the wall to the required thickness. The walls were 13 inches thick at the bottom and tapered to 5 inches at the top. The floor was about 4 inches thick and reinforced with mesh in both directions. It has been in use about a year now and is giving perfect satisfaction. The contract price was $45,000 complete, which was less than bids that were received by the city for a poured concrete tank of the same dimensions. Labor and material prices when the job was built were about at their peak, so that a similar tank could probably be built at the present time for much less money.

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*Before the American Water Works Association.

Other Contracts on which Gunite Has Been Used

At Kansas City, the Turkey Creek reservoir was lined last year and put in good shape and beyond the need of repairs for a long time to come. At the present time they are finishing up a portion of the Quindaro reservoir at the same place.

Trouble in maintaining linings, at Council Bluffs due to ice conditions and general deterioration, was experienced. The walls were cleaned off and a coating of reinforced "Gunite" was applied to solve the difficulty. In addition, the new reservoir is having a light coat applied over the surface for water proofing purposes.

The reservoir at Mt. Vernon, Iowa, showed ground water seepage. The reservoir is underground, the bottom being 26 feet below the surface. The seepage amounted to about 100,000 gallons in twenty-four hours when the reservoir was kept pumped down. When it was decided to remedy this condition, the reservoir was pumped down and about 20 weep pipes were put in to take care of the inflow, thus drying the walls. "Gunite" was applied in successive coats, until 5 inches has been placed over the area where the seepage was worst. Finally the pipes were capped and were covered with a knob of "Gunite." No trouble has since been experienced.

One of the largest jobs done this year, amounting to about 250,000 square feet, was the lining of the walls of the reservoir at Nashville, Tennessee. Some work was done at Nashville in 1914 which was successful. The present job consists of coating the entire surface walls with "Gunite," then placing a coating of mastic, and finally a 3-inch coat of "Gunite."

At Pittsburg, Pennsylvania, a few years ago, the Herron Hill reservoir, which is of 10,000,000 gallons capacity and the oldest in the city, was leaking at the rate of 1,000,000 gallons a day or 10 per cent. It was cleaned out, and a 2 inch "Gunite" lining was applied, reinforced in both directions with American Steel and Wire triangular mesh. It was estimated that a saving of $70,000 was effected on this job by using "Gunite" rather than a poured double slab, which was what they had originally intended to use. The lining was made continuous with no expansion joints. A solid panel fence was built around the reservoir and a watch house was built with the cement-gun. A test made after the completion of the work showed a loss of less than 10,000 gallons in twenty-four hours, with no correction for evaporation.

Much the same methods were used in lining the Lake Elizabeth reservoir on the North side of Pittsburgh, and this fall it was decided to line the Highland reservoir No. 2. This is a 100,000,000 gallon reservoir and totals 750,000 square feet, of which about 75,000 square feet are being surfaced this fall and the remainder is to be done next season.

In addition to the projects enumerated above, brief mention should be made of similar work carried out at Montreal, Quebec, on the Outremont Reservoir, at San Francisco, California, on the Twin Peaks Reservoir, at Elmira, New York, and at Great Falls, Montana for the Anaconda Copper Company.

Port Credit Water Works

Contracts have been let by the Village Council of Port Credit, Ont., for slow sand filters, reservoir and pumping station to George B. Moogk, Weston, Ont.; cast iron pipes for this installation will be supplied by the National Iron Corporation, Toronto; special castings, Dominion Steel and Foundries Ltd., Toronto; overhead tank, Canadian Des Moines Steel Co. Ltd., Chatham; valves, T. McAvity & Sons, Ltd., St. John, N. B.; venturi meter and valve boxes, Francis Hankin & Co., Montreal chlorinating apparatus, Wallace & Tiernan, Toronto; contracts for pumping equipment, hydrants and laying of water mains will be awarded within the next few weeks. Gore, Nasmith & Storrie, Confederation Life Building, Toronto, Ont., are consulting engineers.

R.A.I.C. Meeting

The Royal Architectural Institute of Canada which is allied with the Royal Institute of British Architects, and is a federation of the Alberta, Manitoba, Ontario, Saskatchewan and Quebec Associations of Architects and the Architectural Institute of British Columbia, will hold its fifteenth annual assembly in Winnipeg on September 25th, 26th and 27th. An interesting programme has been provided. Headquarters of the Assembly will be at the Manitoba Club, where all meetings of the Council and associations of the Assembly will be held.

Construction Notes

The Sherwood Construction Company have at present under way two big jobs at Schreiber, Ont. They are erecting a town hall for this municipality, at a cost of $30,000, which will be a two-storey and basement structure of concrete construction. The other job is the replacing of the old dam at Cook's Lake, the source of the town's water supply, with a new concrete structure. The new dam will be five feet higher than the old one, which will increase the town's water supply considerably.

Several officials of Essex County, Ont.. including: John F. Millen, County treasurer; William H.| Knister, county road superintendent: W. H. Ferris, reeve of Colchester South Township and chairman of the highways committee of the County Council; Walter Papst, reeve of Anderdon Township, and A Pettypiece, of Anderdon, a foreman on the county roads, have returned from a five day motor trip through eight counties in Ontario, where they inspected gravel pits, road machinery, and the methods used to repair roads.

Incorporations

The Wm. Ziff Co. Ltd., with head office at Montreal, capital $250,000, to carry on the business of a wrecking and salvage company.

Gillis Quarries Limited, with head office at Winnipeg, capital $250,000, to take over the quarrying business of August Gillis & Son.

Universal Contractors, Incorporated, with head office at Montreal, capital $20.000 to carry on a contracting and building business.

Austin & Nicholson. Limited with head office at Chapleau, Ont., capital $1,000,000, to carry on the business of general contractors, lumbermen, shipbuilders, etc.

The water supply of Montreal will be considerably increased by the recent addition of a 12-million gallon pump at the McTavish street reservoir, which will double the pumping capacity of that station.

The Contract Record's

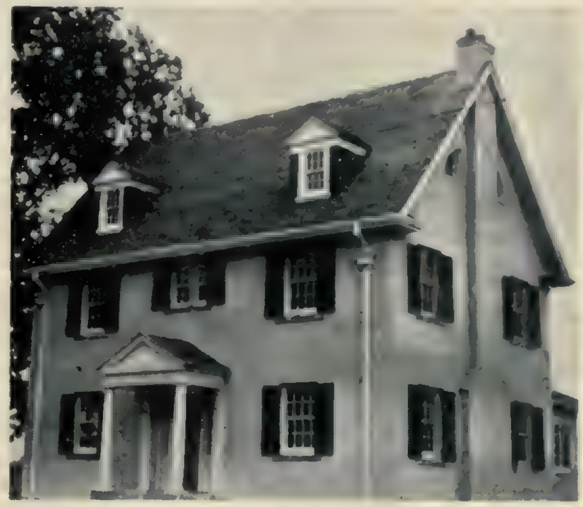
Weekly House Suggestion No. 35

We present here another of Toronto's pretty homes. This house has just been completed on Inglewood Drive, in the beautiful Moore Park district. It is of stucco, with stone foundation and trim and wooden shingle roofing. The pretty front entrance opens on a through hall which divides the first floor into two sections, with large living room and sun room on the right and dining room and kitchen to the left. The floors throughout the house, with the exception of the attic, are of oak and the entire trim is clear pine, finished with six coats of white enamel. The mantel in the living room is of brick, with tile base and wood trim, also finished in white enamel. The dining room and kitchen are both good sized rooms and the latter is equipped with built-in ironing board and cupboards. The electric wiring is a feature in this home, there being no less than 60 outlets throughout the three floors and basement. The staircase to the second floor is located on the right of the hall, as seen on plan and is finished in mahogany and white enamel. There are two entrances from the rear, one on the kitchen and the other through double French doors on the sun room.

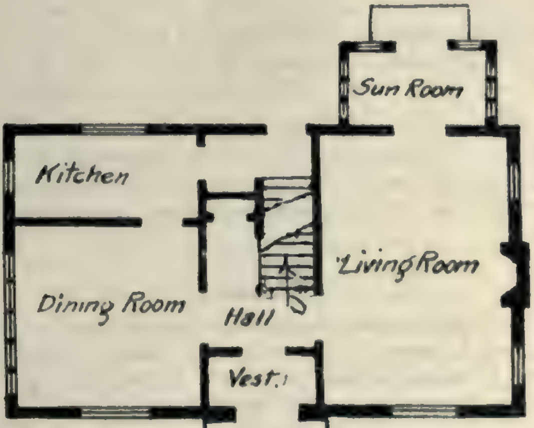
The feature of the second floor plan is the large bedroom on the right of the hall, which is exactly the same size as the living room on the ground floor. The bathroom is finished with white tile flooring and walls to a height of about 5 ft.

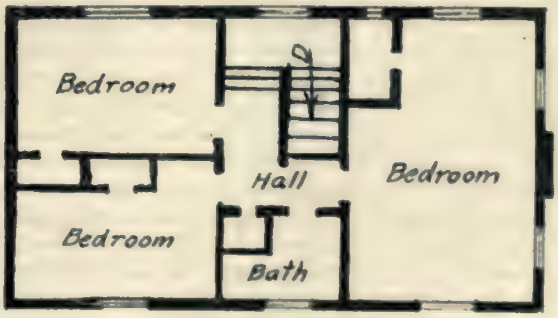
The attic is composed of a bedroom, unfinished storeroom and bathroom, the floors and trim being of pine, the latter finished in white enamel in the bedroom and bathroom.

There is a full sized basement under the house, the floor of which is of super-cement, which Mr. Nasmith, the builder, uses exclusively for basement floors. There is a through hall in the basement as on the other floors, with a toilet at the front end. The furnace room and coal room occupy the space to the right of the hall and a large laundry and drying room run the full length of the house to the left of the hall.



The house was built by Mr. D. W. Nasmith, of 282 St. Clair Ave. East, Toronto.





Mainly Constructional

Eastand West—From Coast to Coast

The Carmichael Waterproofing Company, of Toronto, have the contract for the Hydro Electric Power Commission's generating station at Queenston, Ont. Four-ply roofing will be used on this contract, covered with 6 x 9 tile. The job includes copper flashings, etc., and will cover 600 squares.

The addition of a new building to house the machinery exhibits at the Canadian National Exhibition, Toronto, is spoken of in recent newspaper reports and it is said that plans are at present being laid for its erection in time for the 1923 Fair. The proposed location is on the Strachan Ave., front and the extension of Fleet St., being put through by the Harbor Commission. The building will be 450 ft. long and will be served by a railway siding through the centre of the building, from which machinery may be unloaded and deposited in position by cranes. The estimated cost is $350,000.

By a vote of 52 to 12, owners of property effected by the annual freshets of the Vedder River, in British Columbia endorsed a scheme formulated by the provincial department of public works, whereby the stream will be brought under control and the danger of flood conditions will be eliminated. The proposed scheme will cost about $75,000 and contemplates the straightening out of the channel, clearing of log jambs along a four-mile stretch above the Vedder crossing and the rebuilding of the rock wall at that point.

The big plant of the International Nickel Company at Copper Cliff, Ont., commenced operations recently after a shutdown of 18 months. The plant is operating at about one-third of its capacity during the war, working an 8-hour shift and employing 650 hands. Regular shipments will be made to the refinery at Port Colborne, Ont., where all of the refining will be done hereafter, the refinery at Bayonne, N.J., having been scrapped. The refined nickel will be shipped to the new $2,000,000 rolling mills at Huntington, Virginia, where it will be rolled into malleable metal and marketed mostly in the United States.

Malakwa, B. C.—The new Sicamous-Revelstoke highway in British Columbia, has been officially opened by the premier of the province, completing another link in the Atlantic-Pacific highway. The new road is 58 miles long and traverses a region of mountains and valley of transcendent beauty.

Ground was broken recently for the first unit of the Western University, at London, Ont., recently. The building site occupies 250 acres and the buildings are all to be constructed of grey stone in the collegiate Gothic style.

It is stated in newspaper reports that tte Hull Electric Company are planning a hydro-electric development at Paugan Falls, P.Q., and that engineers are at present engaged on plans for a dam 125 ft. high, to be erected above the falls which are on the Gatineau River. Mr. G. Gordon Gale, vice-president and general manager of the Hull Electric Company, first investigated the possibilities of this scheme in 1916. Messrs. Walter J. Francis & Co., consulting engineers, Montreal, were engaged to survey and report upon the property, and in 1918 a score or more of engineers were engaged for several months investigating the territory. The report made by Walter J. Francis & Co., confirmed the preliminary investigation, and following this report, arrangements were made to acquire the properties which would be flooded by the proposed dam.

House and Senate conferees on the tariff bill at Washington have tentatively agreed on a duty of 25 cents a thousand on shingles. The house rate was 50 cents. The senate put them on the free list.

The second and final shipment of equipment for the huge clock to be installed in the new Sailors Memorial Tower at Victoria Pier, Montreal, left London, Eng., recently. The tower has been completed for several months and the installation of the clock will complete the structure. The tower is 121 ft. high and is one of the most imposing memorials in Canada. The tower was designed by Paul Leclaire, assistant chief engineer of the Montreal Harbor Commissioners. With the completion of the clock the memorial will become the official time-setter for the port of Montreal, and for the first time a noon-day gun will boom the hour at the base of the tower, checked daily by the McGill University observatory.

Permits issued in York Township, Ont., during August, amounted to a little over $1,000,000, which figure is about $200,000 over the August, 1921, total. Home building was the big item in last month's total.

Reports of damage done to roads and bridges in New Brunswick by flood conditions brought about by the recent heavy rains are being received from various parts of the province. Although the total damage as yet not known it is roughly estimated that it will reach at least $100,000. This is the second experience the province has had this year with flood conditions, the freshet early in July doing about $200,000 damage to roads and bridges.

A two-day convention of the Canadian Deep Waterways and Power Association will be held at Welland, Ont., on Tuesday and Wednesday, September 19 and 20. The convention is being held about two months earlier than usual, as there are many important matters which the association wishes to discuss before parliament adjourns.

Personal

Fred. A. McArthur, city engineer of Guelph, Ont., for the past seven years, has tendered his resignation to the city council.

Mr W. J. K. Skillicorn, of Johannesburg, South Africa, and Colonel Hawkes, O.B.E., harbor commissioner of Karachi, India, were two noted visitors at Montreal recently for the purpose of inspecting the harbor and to obtain some new ideas about port administration for adoption in their respective countries. With the party were also Hon. Athanase Davie, provincial secretary of Quebec and Hon. Honore Mercier, Minister of Colonization for the province.

Messrs. W. R. Hunt, Jr., of Westboro, Ont., and H. Baker, of Woodruffe, Ont., have formed a partnership to carry on the business of contracting plasterers and have several jobs on hand at the present time in this district.

Obituary

George Graham, a prominent contractor of Vancouver, B.C. died recently at the General Hospital, Kingston, Ont., after an illness of several weeks, following a stroke of paralysis. Deceased was 70 years of age and was born at Portsmouth, Ont.

Mr. R. W. Powell, a civil engineer of Ottawa, was found dead at Bay D'Espior, Newfoundland, a few days ago, and a rifle was found close by the body. Deceased was a graduate of Kingston Royal Military College and had received the M.C. and bar for overseas service. He was connected with the firm of Harry J. Crowe, of Toronto, at the time of his death. The Department of Justice has ordered an investigation into the circumstances of the shooting.

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED
THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U.S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, September 20, 1922 No. 38

The Solution of Unemployment—Work

The recent conference in Ottawa, on unemployment, seems to have taken an unusually sane view of the unemployment problem. In effect they went on record as opposing financial charity and as favoring the only logical solution, viz:—if a man is out of work, give him work to do.

The earlier pursuit of this policy would have been a big factor in hastening the return of business to normal. During the last two winters when our government and city councils were giving board and lodging to the unemployed, for which no value was sought in return, it would have been infinitely better if the men had been allowed to earn the same amount. Charity, at best, is degrading. Even useless production is better than none. However, there never was a time in our history when **useful** production was more necessary. Wherever we look we see need for building—houses, roads, machinery, harbors, dry docks, canals—there is no end to the useful construction work waiting to be done, to say nothing of vast wheat areas in the West offering splendid opportunities to tens of thousands of industrious men.

The resolution passed by the conference says that "the problem of unemployment is primarily one of industry." This means presumably, that the country's various industries are responsible for keeping men employed. This is reasonable to a degree, but it presupposes a thoroughly efficient organization of industry—which can scarcely be said to exist. It would seem necessary therefore that our governments should be parties to this arrangement—that it should be the governments' duty to see that such an organization actually exists.

Unemployment from whatever cause is a dead loss. The productiveness of every man and woman has an actual cash value. One hundred thousand unemployed not only means some half a million dollars daily cut of circulation but it means an appreciably larger amount than this in finished product—**lost to the nation.** Could anything be more foolish than to literally throw this wealth away? The resolution of the conference was worded as follows:—

"In connection with the attention which has been given by this conference to the subject of unemployment and the measures which may be deemed necessary by the public authorities in Canada to provide for the relief of unemployed persons, the conference hereby places on record, as an expression of its views: That the problem of unemployment is primarily one of industry and that every effort should be made in industry to prevent the occurrence of unemployment."

"It is recognized that the causes of unemployment in some cases may be outside of particular industries and in part due to causes which are international. This conference, however, urges upon those engaged in industry the necessity of regulating employment in the interests alike of employer and employee."

The Pacific Great Eastern Railway

Mr. J. G. Sullivan's frank and outspoken report on the problem which British Columbia faces in the Pacific Great Eastern Railway is a most interesting document, and needless to say, a very instructive one. Although it has been in the hands of the B. C. Government for some months past, it has until the present moment been surrounded by an atmosphere of dense secrecy. Its final though delayed publication reveals a state of affairs even worse than was expected by those who were in a position to know something of the inside of this white elephant of governmental paternalism, and should be a warning against further extension of the practice of "guaranteeing" bond issues for industrial projects which if they are to be of any value to anyone except the original promoters should be able to stand on their own feet.

It also points to the opportunity which is ever more insistently calling to the engineering profession, and its members should realize their place, or rather the place they should have, in large public projects of this kind. The engineering mind is by training, and probably birth as well, more apt to consider the job first, and selfish considerations last, and is like some of the other professions in this respect different from the more commercial interests. Mr. Sullivan broadly hints that the whole scheme of the Pacific Great Eastern had its inception in selfish interests rather than in sound judgment of the economic factors involved. An error of judgment in good faith is always excusable but a deliberately selfish policy which involves a whole people in an enormous debt is not.

The Northern Crane Works, Ltd., Walkerville, Ont., has issued a little bulletin, No. 24-G. It is decribed as a "pidgeon-hole reminder" that they manufacture several types of electric travelling cranes, gantries and electric hoists; also make hand power travelling and jib cranes of various designs.

The Engineering Institute's Annual Meeting at Winnipeg

Three Hundred Attended the Convention—Power Plants in the Vicinity of Winnipeg Were Inspected—Papers on a Variety of Topics; Some of Them Abstracted in This Issue

On Tuesday September 5, about 300 members of the Engineering Institute of Canada, assembled at the Fort Garry Hotel, Winnipeg, to take part in the 36th annual convention, which was claimed to be the most successful yet held. The meeting was opened by Alderman J. G. Sullivan, president of the Institute, who introduced Mayor F. O. Fowler, of Winnipeg, who in turn extended an address of welcome to the visitors. The balance of the morning was taken up with a general discussion of Institute affairs.

After luncheon two of the principal addresses were delivered, the first entitled "Extensions to the Winnipeg Hydro Plant," by E. V. Caton, chief engineer of the Winnipeg Hydro-electric System; the other "Manitoba Power Company's Development at Great Falls." by Frank H. Martin, chief engineer of the Manitabo Power Company, both of these talks being illustrated with lantern slides. The "Contract Record" has already published an article which covers the same ground as his paper.

Mr. Martin took his audience through the construction work of the Great Falls development, from its start to the present time, by means of lantern slides, which he described in a very able manner. These two addresses gave the delegates an excellent idea of what they would see the following day. Following the afternoon session the delegates were driven to the Motor Country Club which is about 12 miles from Winnipeg, and partook of an enjoyable dinner given by the Winnipeg branch of the Institute.

Power Plants Inspected

The second day of the convention was devoted to a trip to Great Falls and Point-du-Bois. Leaving Winnipeg by special train at 8 a.m., Great Falls was reached at 11 a.m., when the party was shown over the construction work which is now being carried on and everything was explained by competent guides. After viewing the works an excellent lunch was provided by the Manitoba Power Company. At 2 p.m. the delegates again took the train for Point-du-Bois arriving there about 4.30 p.m. An excellent dinner was awaiting them, this being supplied by the Winnipeg Hydro-electric System. Following the dinner the guests were shown over the Winnipeg hydro plant by efficient guides. Leaving Point-du-Bois at 8 p.m. the guests arrived back in Winnipeg shortly before mid-night, everybody claiming that it had been one of the most pleasant and instructive days they had ever spent. It is very rarely possible for anyone to have an opportunity of inspecting two large power plants, one in the course of construction and the other completed, in one day. By remarks passed by the out of town members it could easily be seen that they were all surprised at the magnitude of the work that is now being carried on. More than one party stated that it was inconceivable that a city the size of Winnipeg could have two hydro-electric plants of such magnitude as they had that day inspected. A W. McLimont, general manager of the Winnipeg Electric Railway Company acted as host at Great Falls, while Major J. H. Brace, president of the Fraser-Brace Construction Company, the contractors. acted in the capacity of chief guide and lecturer. Major Brace stated that progress with construction was well ahead of schedule and that the cost was slightly below the estimate. He stated that the first wheel of the great plant will be turning by Christmas. J. G. Glassco, manager of the City Hydro System was the host of the party at Point-du-Bois.

In order to get through the programme in time it was necessary to hold two sections on the last day, Thursday, September 7. The first paper read in the Civil section was "Notes on the Construction of the Moncton Yards and Engine Facilities" by S. B. Wass. The other paper in the Civil section for the morning session was "Automatic Grain Car Unloaders for the Canadian National Railways at Port Arthur" by Fred Newell. The morning session of the Geological section had for its paper "The Fuel Values of the Coals of Alberta" by G. R. Pratt.

At the close of the morning session, all members were conveyed in automobiles to the Board of Trade Building where they were given an opportunity of viewing the flower and vegetable show, from where they went to Assiniboine Park as guests of the city of Winnipeg at a luncheon. Short speeches were delivered by Aldermen H. Gray and J. G. Sullivan, of Winnipeg, and G. A. Walken of Vancouver. On returning to the Fort Garry Hotel two papers were given in the Civil section, the first on "Highways in Western Canada" by M. A. Lyons and the second on "The Chemistry of Portland Cement and its Disintegration by Alkaline Ground Waters" by Prof. T. Thorvaldson.

In the Mechanical section, the paper was entitled "Twenty Eight Thousand Horse Power Turbines for Great Falls Development, Manitoba Power Company" written by H. S. Van Patter, and read by Geo. E. Bell.

The convention was brought to a close by a banquet at the Fort Garry Hotel there being nearly 300 present. After entertainment and dinner a few short speeches were delivered, the first on "Agriculture" by the Hon. W. R. Clubb, Minister of Public Works, in the absence of Premier John Bracken. The Minister predicted that the policy of the Bracken government in regard to roads would be to "link up the missing links" in the highways of the province and to institute a system of government maintenance or control as unless good roads were maintained the money spent in construction was absolutely wasted. The next subject was "Transportation" by D. C. Coleman, Western vice-president of the Canadian Pacific Railway, who discussed the question of the public ownership of utilities.

"Education" was the next subject, the speaker being the Rev. E. Leslie Pidgeon, who said that the education problem of the day was to see that every conception of right that we possessed and cherished found an embodiment in public institutions and called into being the most active powers of the individual.

A. W. McLimont, general manager of the Winnipeg Electric Railway Co. was the final speaker of the evening, taking for his subject "Power". He spoke of the immense power possibilities of the plant which the Manitoba Power Co. is now constructing at Great Falls, which will produce 170,000 horse power, available for absorption. Mr. McLimont said that what Winnipeg needed was an abundance of cheap power, as that would bring capital, more industrial enterprise and more population. Hydro-electric power had built up Montreal, Niagara and many other places and it would do the same for Winnipeg, said Mr. McLimont. He believed that Winnipeg with its additional hydro-electric power would attract industries that would not only make the city a great manufacturing centre but the great metropolis of the Canadian North-West.

Moncton Yard and Engine Facilities from a Construction Viewpoint

A Job with Special Contracting Features, Involving a Wide Variety of Work and Unusual Construction Methods — A Detailed Account of the Work

By S. B. WASS

Terminal engineer, Canadian National Railways, Fort William, Ont.

The city of Moncton is situated on the Canadian Government Railways at the junction of the main line from Halifax to Montreal and the line from the city of St. John, and is also the eastern terminus of the Transcontinental Railways. This makes it the gathering point for traffic from the west to Halifax, Sydney and all points east of it, as well as the breaking-up point for traffic in the opposite direction. By reason of this fact it is the most important railway junction point in the Maritime Provinces and requires adequate facilities for handling traffic rapidly and efficiently and also for distributing empty cars and equipment of all descriptions to points where needed. For a number of years the yard has been too small to provide the necessary working capacity, and the tracks too short to accommodate the long trains hauled by the new large locomotives. The roundhouse and other facilities, which were old, were too small and without proper facilities for making the running repairs to the present-day large locomotives.

Layout of the Yard and its Approaches

As will be seen from fig. 1, the old connection with the main line and transcontinental line, with the yard, is near the east end, and by means of a wye connection; the tracks parallel to the west leg of the wye being used for a freight receiving yard from, and those parallel to the east leg as a departure yard for, trains to the north. These tracks were too short to hold the long trains, which resulted in a great deal of terminal detention. All of the freight coming to and from these tracks had to be shunted across the St. John main line, which caused an excessive amount of shunting and congestion. To eliminate this condition, and so simplify yard movements, a diversion was constructed from mile 3.5 on the north main line to mile 2.5 on the St. John sub-division, thence parallel to the St. John sub-division to the yard. By this means all traffic enters the yard from the west, making a simple east and west yard, except for the transfer to the Moncton shops, which traffic, being only local, is small. A very complete ultimate layout has been designed which includes east and west receiving yards, classification yard, which may be equipped with humps if required, east and west departure yards, transfer yards, transfer and storage tracks, new car repair facilities, new engine facilities, etc., so located that the construction of any additions or extensions required to meet traffic conditions may be carried on without materially interfering with traffic. This yard is arranged in units so that it may be constructed and operated in sections as the traffic demands. The conception and design of this general layout originated with Collingwood B. Brown, M.E.

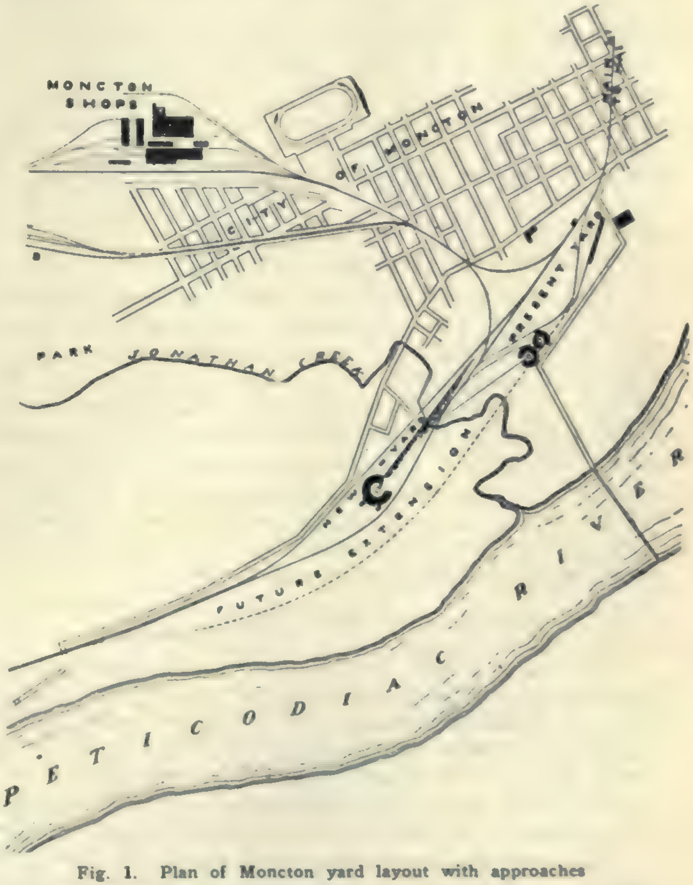
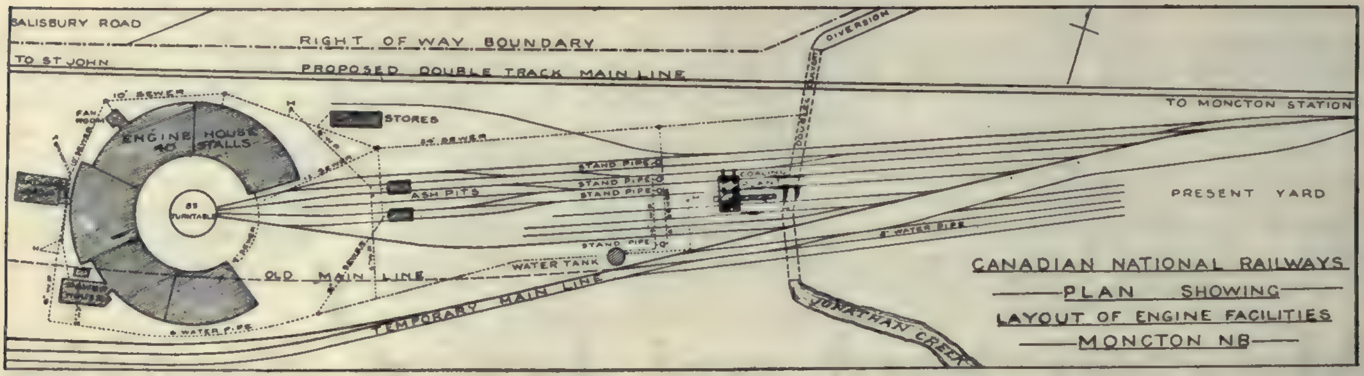


Fig. 1. Plan of Moncton yard layout with approaches



I.C., recently chief engineer, Canadian Government Railways, and now engineering assistant to the vice-president, Canadian National Railways, Toronto. All of the expenditures and construction up to date have been in accordance with this ultimate layout.

Construction Work

The actual work of construction was commenced in the season of 1919, and consisted of three parts:

(1) The acquiring of additional land which was required on both sides of the present yard to provide for present and future requirements, and to avoid farm crossings.

(2) The construction of the diversion from the main line to north, referred to above. The maximum grade was 0.6 per cent, compensated for curvature, and involved the raising of the St. John sub-division, a height of 6.5 feet at the under crossing of the Salisbury road, mile 1.8, and extension of this bridge from a single track to a three track structure. The contract for this work was awarded to the Dominion Construction Company Ltd., and Wheaton, late in the season of 1919, and the work was completed early in 1920. A considerable saving in operating expenses was effected during the first winter by the use of this diversion for freight movement, although the old line was continued for passenger traffic use.

(3) Construction of freight shed and freight transfer platforms. The old freight shed was very inadequate for the local and transfer traffic. A new shed with additional trackage, arranged to conform with the new layout, was constructed. The structure is 400 feet long by 40 feet wide, of brick and structural steel construction. The contract for this work was awarded to engineers and contractors of St. John, and the work was completed early in the season of 1920. A transfer platform 500 feet long was also constructed, conforming to the new layout.

Construction Work during 1920

The engine house, coaling plant, and other engine facilities, are located on the high ground, where foundation is good, just west of Johnathan creek, which crosses the yard at about mile 0.6 and flows across the marsh, the level of which is approximately 25 feet below the grade elevation. This marsh has an average width of about 400 feet, the Johnathan creek culvert being located at its extreme west side. The ground west of the culvert for a distance of 5,000 feet was generally above grade, ranging from zero to fifteen feet, which necessitated a considerable amount of excavation. The material was required partly to widen the embankments at the extreme west end of the yard, but mostly to make the embankment over the Johnathan creek marsh.

An extension of the Johnathan creek culvert under the old yard was also necessary. This culvert is a double six feet by six feet concrete rail top structure and the extension on its upper end is 312 feet long. The original stream crossed the marsh diagonally, necessitating a diversion to bring it to the inlet of the culvert. In order to have the site ready for buildings during the season of 1921, the construction of the culvert extension and grading for the site of the buildings was performed in 1920, so far as it could be done without interfering with the operation of the old yard. A contract for this work was awarded to the Dominion Construction Company Ltd., and Wheaton, and the work was completed by the end of 1920, about 95,000 cu. yds. of material having been excavated and the culvert extension and stream diversion completed. One special feature of this work is worthy of mention, namely, the efficient method of handling the foundation excavation for the culvert and the excavation for the steam diversion. For this work a movable stiff-leg derrick on a base of heavy hard pine timber was constructed, and on it was mounted the hoisting engine, which served at once as a counter weight and supplied the power for operating the derrick for handling heavy material, the orange-peel bucket for excavating, and was also used to propel the whole apparatus by means of deadmen. This machine was placed ahead of the work and rested on a grillage of timber and rails which distributed the load over a considerable area so that no difficulty was encountered in supporting the machine, as is so frequently the case in handling movable derrick apparatus close to the edge of excavation.

Work During 1921

The work during 1921 consisted of continuing the grading, diverting the main line, and construction of buildings and service tracks as shown in figure No. 2. It will be seen that a locomotive approaching the facilities will, under ordinary conditions, obtain the necessary attention in the following order; coaling and sand, water, fire cleaning, housing. Three inbound and three outbound tracks have been provided, all of which are served by stand-pipes for water. Coaling facilities are provided on the three inbound tracks, and by means of cross-overs, locomotives on two of the outbound tracks may be coaled with very little interference with the inbound locomotives. Four tracks have been provided with ash-pits and sufficient cross-overs have been provided to facilitate any desired movement of the locomotives. Fifty tracks to the turn-table have been provided for, four are running tracks to and from the turn-table, forty are entrances from the turn-table to the forty stall house, which is now constructed, and space for an additional six stall section when required. All buildings except the water tank and coaling plant are constructed of brick on concrete foundations with mill type frames of B. C. fir, excepting the machine shop which has a structural steel frame. This is one of the largest layouts for a single engine house in Canada.

As much of this work had to be performed in the present yard, without interference with traffic, it was decided to do it by the railway's own forces under the supervision of the chief engineer, A. F. Stewart, with the construction engineer, S. B. Wass, and assistant engineers, E. R. Evans and H. L. Currie, directly in charge of the work.

When the work was approved very few detail drawings were prepared, and these were made as quickly as possible in the chief engineer's office by H. J. Crudge, assistant engineer of buildings, R. G. Gage, signal and electrical engineer, and C. S. G. Rogers, assistant engineer of bridges, for ash-pits, and steel water tank. The field work was divided into two units, each reporting to the construction engineer, and each consisting of assistant engineer and a small staff, with general foreman, and as many other foremen as necessary. One timekeeper and one materialman, with some temporary assistants were employed on the whole work. E. R. Evans was assistant engineer in charge of grading, etc., with T. McPherson as general foreman, and H. L. Currie was assistant engineer in charge of buildings, with D. A. Seaman as general foreman. G. N. Allen, was timekeeper on the whole work. Special attention was given to the design and installation of the heating and piping systems by H. F. Finnemore, and to lighting by F. H. Williams, both assistants to Mr. Gage.

Several small contracts were awarded for special work as follows: Steel water tank, Dominion Bridge Company, Montreal; coaling plant machinery, Williams and Wilson, Montreal; tar and gravel roof, Carrite Company, St. John; plumbing, Johnston Bros., Moncton; oil storage system, B. F. Bowser Company, Toronto.

Grading

It will be seen, by reference to figure No. 2, that the main line of the St. John sub-division and the Reid's cut yard lies across the site of the proposed engine house, on a grade, and at a different elevation than that of the new work. It was therefore necessary to construct a new main line well in advance of building operations. Owing to the necessity of maintaining traffic, cutting both sides and under the main line, and to the irregular shape of the excavation required, ten cuts of the shovel were required; this with the shallow excavation, varying from two to fifteen feet, entailed a comparatively large amount of shifting of the shovel. The material encountered was heavy clay and hard pan. Some of it was used to widen the embankments at the west end of the yard, but most of it was deposited in the embankment over Johnathan creek marsh. The equipment used consisted of one model-60, Marion steam shovel, twenty-four Kilbourne and Jacobs, 16-yard air dump cars, one Jordon spreader, and two Consolidated locomotives.

In view of the shallow excavation and the settlement in the marsh, the shovel record would seem to be good. The shovel started work on April 11th and completed September 14th, having excavated 158,000 cubic yards, averaging 31,600 cubic yards per month, or 1,200 cubic yards per working day.

Sewer System

As the buildings were all located on the natural ground, composed of hard pan, very impervious to water, it was important that drainage be provided for the foundation excavations at the earliest possible moment, and the most effective method was to get the permanent sewerage system installed. This was entirely new and independent of all other sewers except for the coaling plant sewer, which, on account of its proximity to the culvert, has a seperate connection with it. It discharges into the top of Johnathan creek culvert through a specially constructed manhole near its upper end.

The main sewer, extending from the outlet to the manhole opposite the ash-pits, is of twenty-four inch double strength, vitrified clay pipe 798 feet long, placed fourteen feet below grade so as to drain the ash-pits. From this main sewer, branches of smaller sized pipe are carried to the turn-table pit, engine wheel drop pits, and all other facilities requiring drainage. The total amount of excavation for sewer trenches was 4,960 cubic yards in hard pan material merging into rock, so that hand labor was considered to be too slow. Several alternative methods were discussed and it was finally decided to try a Marion railroad ditcher which was available. This machine was supported over the top of the trench on old bridge stringers and in one operation excavated the trench in front of it and deposited the material behind itself, the pipe having been laid and jointed by men working directly underneath the machine. Some difficulty was encountered with a seam of quicksand about ten feet below the surface which caused the sides of the trench to cave in, but this was only for a short distance. The machine would dig only about ten feet below its support, so in order to excavate the bottom of the trench the machine had to make a surface cut, about four feet deep, wide enough to permit the timbers to rest on the bottom of it. So successful was this method that frequently fifty-five lineal feet of completed sewer was laid in a working day, and an average of thirty-two lineal feet per day was maintained during the whole sewer operation. The cost of trenching under the conditions encountered was easily less than half what it would have been by hand. The main sewer was commenced on April 28th and was carried almost to the turn-table, so that all foundations could could be readily drained by May 30th. The early completion of this sewer removed all necessity of pumping water from foundations.

Description of Buildings

The stall engine house contains forty stalls, thirty-three of which are 100 feet in length with 65-foot pits, and seven are 120 feet long with 80-foot pits. The house is divided into sections each of which is separated from the adjoining sections by fire-proof walls and doors. The sections are as follows: Commencing on the south-easterly corner, two sections of seven 100-foot stalls; one section of seven 120-foot stalls; one section of nine 100-foot stalls, and one section of ten 100-foot stalls. Three of the long stalls are provided with drop pits for driving wheels, and two with drop pits for tender wheels, so located that any pair of wheels on any of the railway's existing locomotives may be changed. The drop pits are all equipped with Taylor-Arnold pneumatic jacks. Each stall is provided with steam blower, with Barco connection, blow-off pipe, wash-out and boiler filling pipe, cold water connection, compressed air, all of which systems are connected with the power house, where the various pumps, hot-well, etc., are located.

The machine shop which is 84 feet long by 53 feet wide and is located at the back of the long stall section of the roundhouse and connected to it by a passage-way is provided with machines for light repairs, tool room and forge with jib cranes for handling heavy parts, and a narrow gauge push-car track between the machine shop and the roundhouse stalls.

The stores and office building is 100 feet long by 30 feet wide. The foreman's office is in the west end of the building, and adjoining it are the booking and registering room, locker room, shower bath, etc. The oil cellar, fully equipped with storage tanks, and ten self-measuring and registering oil pumps, is in the central portion of the building. The eastern end of the building to be used for miscellaneous supplies, is fitted with racks and shelves, and surrounded with an eight-foot platform with ramps. This building is heated by low pressure steam, supplied by the power house boilers.

The power house is attached to the back of the twelfth stall of the engine house and is eighty-seven feet by forty-four feet. It is divided into two parts by a brick wall, the back part of which contains two 250 h.p., Babcock and Wilcox water-tube boilers, which were in use in the old power house, but have been retubed, thoroughly cleaned, and repaired. The other part contains the air compressor, feed-water, wash-out and vacuum pumps, and steam driven fan and heater coils. A hot-well is located just outside the power house for storage of hot water. This hot water is used for feed water, refilling locomotive boilers, thus affecting a great saving in fuel.

The electric current is obtained from the railway's own system developed at the Moncton shops. It is used for operating the coaling plant and motors in the machine shop, in addition to a complete lighting system throughout. The lights in the engine house are so arranged with reflectors on the posts that an abundance of light may be obtained for work on any part of the engine, but economy may be effected by turning off those not required, as each stall is supplied with separate switches.

A mechanical coaling plant of 350-ton storage capacity, equipped to elevate coal at the rate of fifty tons per hour, was installed. It is provided with three coaling tracks, and one hopper track for receiving coal. It is operated by electric power from the railway system. The machinery was supplied and installed by Williams and Wilson Limited, of Montreal, under contract, but the construction of the building and all other work was done by the railway forces. Facilities are also provided for sand storage and supplying sand to locomotives at this plant.

Water is obtained from the city water-supply and a connection with the present nine inch main just opposite the passenger car power house, and an eight inch cast iron pipe, 3,343 feet long, was carried to the new facilities. A steel tank of 150,000 gallon capacity is provided as a storage reservoir. Four ten inch standpipes are provided for watering locomotives, also connection to all buildings and facilities. The steel water tank was supplied and erected, by the Dominion Bridge Company, under contract, on a concrete foundation constructed by the railway forces.

Two double track ash-pits, forty feet long, were provided. These pits are twelve feet deep and so arranged that they may be operated as dry or flooded pits. They are constructed of reinforced concrete walls, lined with fire brick, with the sloping wall of steel rails under the tracks. The space between the two tracks, over the deep part of the pit, is covered with a wooden platform which is removed when the cinders are being taken out of the pits. The ashes are removed from the pits by a coaling crane with a clam-shell bucket. This crane is also used to load coal engines in case the plant breaks down.

Construction of Buildings

As all the buildings were required for operation at the same time, it was decided to carry on the construction of them simultaneously and thus prevent the work from becoming congested. For purposes of organizing a construction force, a fairly close estimate of the quantity of each class of work to be performed was made and from it an approximate estimate of the number of men and time required to perform each was obtained. By keeping in view the natural sequence of the work, a program was worked out by which the foundation work was kept well ahead of the concrete work, the concrete work ahead of the brick work, the brick work ahead of the carpentry, painting, piping, etc., and throughout the whole work there was very little interference of one class of work with another, so that a gang once organized to perform certain classes of work was kept up to full strength until the work was practically finished.

Bills of material were also prepared, orders were placed for these as early as possible and arrangements made for delivery in accordance with the general programme of the work. By keeping daily records of material on hand, and by keeping the persons supplying the material daily advised of the material situation at the work, no serious delay was caused for material, although in some cases the men had to be shifted to another part of the work for a few days. This was true in the case of the steel window lintels, reinforcing for the concrete floor in stores building, pipe fittings and electrical supplies. Notwithstanding this the general programme of the work was very closely adhered to.

Foundation Excavation

The material encountered in the foundations was all a stiff clay or hard pan, merging into rock, which made hand excavation very slow and expensive. As the site had been levelled to sub-grade the previous year, practically all the material from the excavation had to be hauled to the embankments as it was not suitable for filling near the surface, which made it very important that some mechanical means be obtained for loading it, especially where the quantities were large.

The back wall of the engine house and hot-air duct required a trench about eight feet wide and four feet deep, and contained about 1,600 cubic yards, nearly all of which was excavated and loaded on dump cars by the railroad ditcher, which was supported over the top of the trench by the same bridge stringers used on the sewers. The turntable-pit contained 1,950 cubic yards and was all excavated by the ditcher except the footings, which were cast out by hand, sufficient material having been taken out to permit this.

The excavation for the pits and pedestals in the engine house presented a difficult problem as these covered a large shallow area. An effort was made to excavate this with an orange-peel bucket, operated by the locomotive crane, but this was not successful, the material being too hard. Finally the ditcher was used, but had the disadvantage of excavating a larger area than was required for the actual footings. A considerable amount of track shifting and shunting was entailed, but it worked out to be the most economical method available.

About seventy-five per cent. of the excavation for the deep ash-pits was performed by the ditcher, the lower part of it was handled twice, the ditcher not being high enough to load the material into cars when lowered into the excavation to reach the bottom.

The foundation excavation for machine shop, power house, tank, and stores building, was all done by hand as the material, especially in the case of the latter, was required for backfilling in and around the building. The excavation for the coaling plant was partly done by teams with scrapers, partly by hand, and partly by the orange-peel bucket operated by the locomotive crane.

Concrete Work

The total quantity of concrete is about 5,300 cubic yards. Several methods of mixing and distributing this were considered, but as the concrete was practically all to be placed below rail elevation, and was distributed over a comparatively large area, it was decided to use small mixers, set up at convenient points close to the work, and so avoid transporting the concrete long distances. Two concrete gangs, consisting of foreman, mixer runner, and twelve to sixteen laborers, were organized, using two London gasoline mixers of six cubic feet capacity. The aggregate was from one-quarter inch down, the coarse aggregate was from one-quarter inch to two and one-half inches in size. For all foundations, piers and engine-pits, the concrete was proportioned: one part portland cement, two and one-half parts fine aggregate, to five parts coarse aggregate. For the thin reinforced concrete walls of the main heating duct, the floor over the stores oil cellar, concrete window sills and lintels, a mixture of 1:2:4 was used. To waterproof the hot-well walls and floors, hydrated lime was added to the mixture, eight per cent. of the weight being used. The material was put into the mixer dry, along with the other aggregates.

The site was such that the cars could be spotted close to the mixers, and the material, including the cement, wheeled directly from car to mixer, with one handling only. This affected a great saving in the cost of labor. The mixture was wheeled from mixer to forms with St. Clair carts of six cubic feet capacity, which were carried on plank runways at the elevation of the top of the forms. The forms were made of two inch dressed spruce in sections, so that they were used over and over again. In constructing the backwall and hot air duct about 300 lineal feet of sectional forms were built, and by taking these down and moving them ahead, the whole duct, over 1,200 feet long, was constructed with the same set of forms. The same method was also used with pedestal forms, engine pit forms, etc. After removing the form it was cleaned and oiled before being used again.

The first concrete was poured on May 12th and by November 15th, the whole 5,300 cubic yards had been placed with the exception of a few odd jobs which were delayed waiting for material or other similar cause. In addition to pouring concrete, these gangs were used, especially that with the small mixer, in excavating foundations by hand, or other necessary work.

Brick Work

The brick work was commenced on May 26th as soon as the concrete foundation was ready to receive the same. At first a small force was employed, as the walls could not be carried above the top of the windows until the steel window lintels were received, which was on July 5th. After that the force was increased to twenty-six bricklayers, and maintained at that until the walls were up, on October 20th. Approximately 1,190,000 brick were laid, of which 400,000 were second hand from North Street station, Halifax. The remainder were new brick from Pugwash. Cement mortar consisting of three bags of cement, one bag (50 lbs.) of hydrated lime, with three-eighth cubic yard of Shediac sand, was used. For the first month this was mixed by hand, but after that a gasoline London concrete mixer was used. This worked out very satisfactorily, as the mortar was much more uniform and was received by the bricklayers much fresher. Five men with the mixer had no difficulty in supplying mortar to twenty-six bricklayers, where twelve or more men had been required before.

Frame and Roof

The frames of all buildings, except the machine shop, were of British Columbia fir, most of which was received in April, and framing was proceeded with at once. Templates were made for each member of the engine-house frame, and resulted in saving a great deal of time, and in getting very uniform work and a good fitting frame. The frame for the coaling plant was also framed early, and erection commenced July 18th, as soon as the foundation was ready. For erection a 15-ton locomotive crane with 35-foot boom was used, and was a very great labor saver. This crane was used in erecting the second storey of the coaling plant, above which it would not reach, and the timber was erected by gin pole. The frame for three stalls could be erected from one track, and a foreman with eight men and the crane frequently did this in one day. After the frame was erected the crane also hoisted most of the sheathing to the roof, which was unloaded from the cars on the ground in sling loads, where it could be picked up by the crane.

The work of erecting, fixing joints, and bracing, went on almost continuously and was followed very closely by a gang of carpenters placing sheathing, smoke jacks, cornice and gutters; so that the roofing contractor, who came on the roof as soon as the first two sections were passed, worked continuously to the end of the work without delay. Erection of the frame was commenced on August 10th, and the crane finished hoisting roof sheathing on September 29th, having erected frame and roof material on the 40-stall engine house 89,500 square feet in area, during that time.

Heating and Piping

The foundations for boilers, air compressor and heating fans were poured at the same time as the foundations for the power house. The vitrified clay pipes connecting the hot air duct with the engine pits, were started just after the pouring of the pits, and followed around simultaneously with them.

Much of the equipment from the old power house including the two 250 horse-power Babcock and Wilcox boilers, air compressor, piping, etc., was to be used in the new. As it was not possible to ascertain just how much of this equipment could be used again, and what repairs it would require, until it was taken down, this part of the work was commenced about July 15th. It was found that all tubes in the boilers required renewing, and that extensive repairs were necessary to the air compressor, and other equipment. The piping in the engine house was commenced as soon as the roof sheathing was well under way, and was continued around the building simultaneously with it. Considerable delay was experienced in obtaining some extra heavy special fittings for the steam and heating plant, but notwithstanding this the whole heating plant, air and water systems, were put in operation prior to the house being opened for operation. A total of 11,600 lineal feet of piping was installed in the buildings.

Permanent Tracks

During the season 7.03 miles of permanent track with 43 switches were laid. This work could not be done continuously but the layout was located on the ground, and wherever possible service tracks were laid in the position of permanent ones. A large amount of old track had to be taken up and shifted, and the locomotive crane was very useful in handling this material.

It was necessary to continue operation at the old facilities until the new ones could be used. About one-half of the machines in the old shop were belt driven, and these were installed in the new shop, while the motor driven machines were left in the old shop until after the transfer had been made.

The transfer of the turn-table naturally was the governing feature, this was accomplished without any interference with traffic. The table was put out of service at the old house at 8:00 a.m. December 17th, and was raised out of the pit without removing deck or rails, by a 75-ton wrecking crane, by a rather unique method. The crane lifted one end of the table, blocking was placed under the centre, the table was then tilted over the blocking and the opposite end blocked up. By repeating this several times the table was raised high enough to permit car trucks with especially constructed bolsters to be pushed under the table. By this means the table was transferred to the new site by 4:00 p.m., where it remained till the following morning. During the night the crane was taken away on other service, and it returned at 11:00 a.m. By reversing the tilting process the table was lowered into the new pit, and at 4:30 p.m. December 18th the first engine went into the new house.

The total quantity of various kinds of work performed is as follows:—

Excavation by steam shovel	158,000	cu. yds.
Trenching for sewers	4,960	cu. yds.
Trenching for water pipes	3,690	cu. yds.
Foundation excavation for buildings, ash-pits, tank, etc.	12,670	cu yds.
Concrete poured	5,315	cu. yds.
Brick laid	1,190,400	bricks
British Columbia timber	392,000	ft. B. M.
Other timber and lumber	1,025,000	ft. B. M.
Steel water tank	150,000	gallons
Structural steel	57	tons
Reinforcing rods	31	tons
Reinforcing rails	13	tons
Sewer pipes	3,683	feet
Cast iron water pipes	5,460	feet
Hot air pipes	2,350	feet
Wrought iron piping	11,600	feet
Stand pipes	4	
Fire hydrants	5	
Permanent tracks	7.03	miles
Permanent switches	43	
Ballast and cinders	40,000	cu. yds.
Roof area	1,073	squares
Glass area ....(Approx. 10,000 lights)	8,300	sq. feet.

Extensive Improvements for Ford City, Ont.

The Town Engineer, in a Report, States That Sewers and Water Service Are Needed, as well as Other Facilities

In view of the extensive plan for civic improvements in the near future in Fort City, Ont., town engineer Patterson submitted a detailed report to the Ford City Town Council September 5, giving a survey of improvements already possessed by Ford, and the amount necessary to bring the town up to the proper standard of municipal advancement.

Dealing first with the history of the town, Mr. Patterson says: The town up to the present has been provided very slowly with local improvements of all kinds. The old section of the town lying north of the Grand Trunk and Essex Terminal Railways has been provided with 99 per cent. of sewers, 99 per cent. of sidewalks, 50 per cent. of pavements, 99 per cent. of water mains, 69 per cent. of hydrants, 60 per cent. of fire and police signals and 62 per cent. of street lighting.

"In the newely annexed portion of Ford, all land south of the Grand Trunk and Essex Terminal Railways has only a small amount of municipal work completed, including sidewalks and water mains.

"Street openings show that blind and jogged streets prevalent in the old portion of Ford have been rectified to some extent, but there are still several changes to be made. The main changes will be provided by the proposed subway routes, the subway being considered as part of the street openings.

"Dealing with the water services, the old portion of the town is completely supplied, the non-installation of sufficient hydrants being the chief drawback. Hydrants are as necessary as service connections to houses, and should be installed as soon as the first house in a district is erected.

"Sewers are an absolute necessity to sanitary conditions. All parts of the old town have been completely supplied with sewer services. In the new section of Ford, the council will have to consider the installation of a complete new system. This can be done by degrees once the main outlets are provided, according to the rules of the Provincial Board of Health.

"The sewer system can be considered by Ford City as its main problem on account of its high cost, but if the main outlets are taken first and the laterals second as needed, the cost will be spread over a greater period.

Should the P.G.E. Railway be Scrapped?

Reports of the Investigators Appointed by the Government do not Speak Very Favorably of the System—Mr. J. G. Sullivan Makes Complete Analysis of the Situation

By our British Columbia Correspondent

Very pessimistic reports as to the future of the Pacific Great Eastern Railway have been presented to the government of British Columbia by the three experts employed to investigate that line and drastic action is recommended with a view to putting a stop to the drain on the financial resources of the province which a continuance of the construction programme would involve.

Three reports have been received by the government, of which the most comprehensive is that by J. G. Sullivan, M.E.I.C., former chief engineer of the Canadian Pacific Railway and one of the best known railway engineers in North America. Mr. Sullivan's findings are supported by separate reports presented by Col. J. S. Dennis, director of colonization of the C.P.R., who dealt with the possible future development of the area served by the railway, and by W. P. Hinton, former general manager of the G.T.P. Railway, who reports upon the organization and operation of the road.

Scrap the System

Summing up his report Mr. Sullivan recommends, "If the people of British Calumbia are not prepared to continue paying from $2,000,000 to $2,500,000 per year on the investment already made and what will be necessary in the next ten years, that the company be at once ordered to abandon the whole system and recover what salvage is possible, and in this reduce the liability and also prevent any further increase in their obligation."

Alternative suggestions are made, but it is evident that Mr. Sullivan does not think that under any conditions the province could ever secure an even break on operation account. As to this he says. "The present development of the country makes this desirable result an absolute impossibility. There is nothing in sight at the present time to indicate that this can ever be accomplished. It certainly cannot be done if the present method of financing is allowed; that is, charging to capital the accrued interest and deficit in operating expenses. The interest charges will increase faster than the business. The total indebtedness at the end of ten years will be nearly doubled, without taking into account the extra expenditure that would be necessary to purchase sufficient new equipment to handle greatly increased business."

Recommendations

In view of the possibility, however, that other considerations may force a continuance of operation of at least portions of the line, Mr. Sullivan makes certain recommendations, a summarization of which, and of his answers to certain specific questions propounded by the government, are given below.

1.—The construction of the line between Vancouver and Squamish (the present southern terminal) cannot be justified on any grounds. The short section of line now in operation out of North Vancouver could be held, or preferably sold to a private corporation. There is little doubt that Vancouver is going to be one of the greatest cities of Canada, and that something will be realized from this portion of the property.

2.—Under no consideration undertake any construction north of the G. T. P. Railway, as the competition would be ruinous..

3.—Abandon the line from Quesnel to Prince George and salvage everything that can be sold.

4.—Abandon the operation of steam trains for passenger and express service, and replace these by gas-driven motor cars, which only take about one-fifth the fuel and require only one or two men to operate them. Operate freight trains only when there is business to warrant during the summer months, and do not send out an engine without at least a full load in one direction. Raise rates to all the traffic will bear, that is, just meet competition, but encourage development as much as possible by giving commodity rates as long as the rate is slightly above cost.

5.—That if the fourth suggestion, as it stands or modified, is acted upon, the possibility of abandoning or selling the entire ling south of Clinton be considered as a means of justifying the further outlay of building the Clinton-Ashcroft cut-off, which would give direct rail connection with Vancouver.

6.—That the province does not guarantee any more bonds for the construction of branch lines, which should be financed on the security of the resources they are to serve.

7.—If the people of British Columbia are not prepared to continue paying from $2,000,000 to $2,500,000 per year on the investment already made and what will be necessary in the next ten years, that the company be ordered to at once abandon the whole system and to recover what salvage is possible.

While there is little to critize about the details of the route of the P.G.E. Railway, according to Mr. Sullivan, he has never before seen such a large area of country where the physical features are so adverse to the economic construction of a railway. Mentioning the difficulties encountered in the building of the Panama Canal, he says if the percentage of solid rock to other materials in the Panama was as small as it is on the P.G.E., and if the other material on the Isthmus was as unsuitable as the material on the P. G.E., then the canal would never have been completed.

Capital Required to Complete Line

On the point of the general construction situation, it is estimated that to complete the section from North Vancouver to Squamish of which 12.7 miles has been built and 29 miles has not been touched, would cost between $3,500,000 and $4,000,000. From Squamish to Quesnel a distance of 350 miles, the line is constructed and in operaton. From Quesnel to Prince

George the grading is completed with the exception of cleaning out slides that have occurred since the line was graded six years ago. The track is laid from Quesnel to Cottonwood River, seventeen and a half miles, and also from the junction of the P.G.E. with the G.T.P., about one mile east of Prince George, to Red Rock Creek, eighteen miles south of Prince George, leaving a gap of forty-five miles without steel. The steel for this work is on the ground. Cottonwood River is to be crossed by a steel viaduct requiring about 2,450,000 lbs of steel, of which 2,262,565 lbs. has been fabricated and paid for, and is laying at Walkerville, Ont. None of the concrete foundations for this bridge have been started. In addition there is some 8,000,000 f.b.m. of trestles to build, nearly all of which timber is on the ground and paid for. To complete this gap and put the line into condition to operate will cost from $500,000 to $600,000, and to operate will require extra equipment estimated to cost $1,500,000. To put the line from Quesnel to Prince George into operation will require over two millions new capital, and to complete both gaps between North Vancouver and Prince George would call for about $6,000,000 new capital.

The type of construction used has been up to good branch line standards, with 70 lb. steel on grades ot 2 and 2.2 per cent. and 60 lb. steel at other places. Timber spans on bridges, culverts, etc., have been much used, but this is not economical and replacement with permanent structures will cost over eight millions in the next ten years.

Financial Status

The outstanding financial debt of the company is $44,226,403.12 of which $5,925,195 is held by company, leaving outstanding $38,301,208.12 on Dec. 31st, 1921, on which interest for the year ending on that date amounted to $1,911,913.14. The total investment in the road and equipment up to the same date was $38,438,590.23 after various assets amounting to $5,618,248.41 were credited. Of that investment $10,543,530.79 has been expended in paying interest charges during construction and deficit in operating revenue during construction.

During the year ending Dec. 31st, 1921, the P.G.E. carried 15,,290 passengers for a total of 1,462,871 passenger miles; total receipts from this business was $63,889.87, or at a rate of $0.043 per passenger mile. Passenger earnings per mile of road operated were $323.86. During the same year there was handled 53,351 tons of freight for a total of 4,634,231 ton-miles at a rate of $0.057 per ton mile. The revenue per mile of road operated was $844.70. The total gross income from all sources was $484,326 and total gross corporate expenses $2,689,205.14 the net corporate loss being $2,204,878, which was charged up as follows: to interest during construction $1,911,913; to operating loss during construction, $292,965.

A total final investment within ten years of $52,438,950 is estimated from the 470 miles of railroad, or nearly $112,000 per mile, and the interest charges would amount to over $5,500 per mile of road at the least computation. Therefore it is self-evident that this amount of $5,500 is the fixed charge which either the taxpayers of the province or the patrons of the road must pay for the use of the plant. To make $5,500 a mile above operating expenses the road would have to take in $22,000 per mile and operate at a ratio of 75%. The Canadian Pacific Railway operating ratio last year was 82.28%; and if the Pacific Great Eastern Railway could not do any better it would require a revenue of over $31,000 per mile of road.

Will Not Be Enough Traffic

Owing to the fact that the Canadian National Railway has a much shorter and cheaper line to operate to Vancouver than via the P.G.E. connection, the P.G.E. must depend wholly on business developed along its own line. To meet operating expenses an increase of the present business of between 2,400 and 3,200 per cent. would be required. But there is no possibility of attaining this result for three reasons; first, the limited area capable of producing any traffic; second, while the valleys are most fertile when irrigated, very little can be produced on the majority of the land adjacent to the line without irrigation, and third, the water available for cheap irrigation is very limited, and on account of the unstable nature of the ground, other than solid rock, it is very doubtful if any large irrigation scheme could be made an economic success. Therefore, no large agricultural development can be expected in the country adjacent to the P.G.E. The same reasons, with the additional factors of the long winters and the difficulty of procuring winter feet, no further great development of the country as a stock-raising region can be expected. The timber industry is limited to the first sixty or seventy miles, and with the exception of the first twenty miles the timber areas are quite patchy. There might develop some pulp wood business, but on account of the heavy grades this development is far in the future. Nor does mining offer much, for free gold mining, be it placer or quartz, does not produce tonnage for a railway like that produced by the mining of coal, iron or copper ores.

There is only one conclusion that can be reached, namely, that as a local line between Vancouver and Squamish and Prince George the country will not produce enough traffic at any reasonable rate to pay operating expenses plus fixed charges.

Replying to the proposal that has been made, that the line should be extended to tap the Peace River country to the north, the reports proceeds "A second and more conclusive reason why it is necessary to study routes to the Peace River country is that a very exhaustive study of routes from Prince George to Prince Rupert (on the Pacific coast), to Squamish and to Vancouver via Ashcroft, shows conclusively that if there is traffic enough offered in the Peace River country to warrant the construction of a line from the Grand Trunk Pacific Railway, either from Prince George or Vanderhoof to the Peace River district, such traffic will not reach tidewater either at Vancouver or Squamish, but at Prince Rupert."

On the question of abandoning the present line from Clinton south and constructing a line of forty-six miles to connect Clinton with the C.N.R. or C.P.R. at Ashcroft, a fully detailed argument is worked out, and concludes "While there is no doubt that the proposed line is far superior to the line constructed to handle business to Clinton and points north, the present development of the country will not warrant the construction of this line. Do not spend money and increase your liability until the saving will more than pay interest on the investment; this is a very good rule to follow.".

Was Construction Economical?

The question was also asked Mr. Sullivan whether in his opinion the work of construction has been economically carried out since the government took charge. While he states in reply that a proper answer to the question would involve investigations far beyond the scope of his present commission, the report proceeds:

"I do not believe that the cost plus percentage basis is an economical method of performing work unless you can introduce into the contract a bonus clause that will act as an incentive to the contractor to keep the cost of the work down. No matter how honest or efficient your contractors may be, the foremen and workmen will not work efficiently when they have the idea that the more the work costs the more the contractor will make and the less they do the more work there will be. In the case of the Pacific Great Eastern contract this feature was taken care of by the contractors submitting a schedule of the estimated cost of the work, with an undertaking that the sum on which a percentage would be paid would not exceed the sum the work would cost if figured at the unit prices in the schedule, and a further stipulation that if the actual cost of the work was less than what the work would have cost, figured at the schedule prices, then the contractor was to receive as a bonus 25% of such saving in addition to their agreed percentage on the cost. This agreement, coupled with the fact that the company engaged a firm of contractors with a national reputation, would indicate that the work should be performed as economically as it was possible to do the work in 1919 and 1920, when prices were uncertain and wages at the highest point they have ever reached and the efficiency of labor at the lowest ebb in our time. Under such conditions it would have been impossible to do work under any plan that would be considered economical. If you had decided to have the work done on straight unit prices, I believe the contractors, to protect themselves, would have tendered a figure so high that the work would have cost even more than it did under the plan adopted by the company. If there is any criticism to make on the action of the government management it would be for proceeding with the work when construction costs were from 50 to 100 per cent. higher than normal, and at a time when practically all other industrial expansion was at a standstill."

The Possibility of the P.G.E. Being Taken Over

Repeated attempts have been made by officials of the provincial government to get the Pacific Great Eastern taken over by one of the larger railway companies or by the Dominion government. On this point Mr. Sullivan in his report remarks:

"It has been suggested that one of the larger connecting lines might be induced to take over the Pacific Great Eastern Railway on account of the advantage of having it as a feeder to their main lines. The reason given to the people of British Columbia for the government aiding and guaranteeing the bonds both as to principal and interest, of the Pacific Great Eastern Railway, is contained in the first paragraph of schedule A attached to chapter 34, Feb. 27th, 1912, and ratified by said statute: 'Whereas the government of the province of British Columbia deems it in the public interest to aid in the construction of the line of railway hereinafter mentioned, for the purpose of securing to the people of British Columbia reasonable passenger and freight rates, and to assist in the opening up and development of the province.' It is very doubtful if this was the real reason. It would appear more logical to suppose that business interests in Vancouver and Victoria for selfish reasons, aided by the Grand Trunk Pacific influence, was the real force that brought about the Pacific Great Eastern Railway. The G.T.P. might be expected to favor a rail connection with Vancouver, provided the same was constructed at the expense of some other party, and such a connection would have some value to that company, but now that the G.T.P. and one of its chief competitors, the C.N. Railway, have been made one under the management of the Canadian National Railway, the P.G.E. is of no value to the system, other than a feeder to the extent that it may collect traffiic from local inland points.

"The road has no strategic advantages, excepting the possibility that if the craze for building railways should ever demand an Alaskan rail connection, the P.G.E. might become a link in the system; therefore it cannot hope to get from a larger road more than the value of the P.G.E. as a collector of traffic.

"There are thousands of miles of railways in Canada where the total receipts from traffiic, both in and out, will not pay operating expenses of the line plus interest on cost, leaving nothing to pay for the hauling of the traffic over the main lines or foreign lines. But in the case of the P.G.E. the present revenue from traffic in and out will not pay operating expenses of the P.G.E. Railway, to say nothing of interest on plant or cost of hauling traffic over foreign lines. It has been suggested that the P.G.E. might build extensions. I have been driven over some of the proposed lines, and if they are built they will be a further burden on the P.G.E. company for the reason that the total receipts with ten times the present development will not pay inerest on the cost of these proposed lines, nor leave anything for the cost of operating the branch or hauling the traffic over the main line or foreign lines.

Registrar of Ontario Engineers

Mr. R. B. Wolsey who has been appointed registrar and secretary-treasurer of the Association of Professional Engineers of the province of Ontario. Mr. Wolsey is an engineer of varied experience, having received his education and training in English schools and with Mr. Martin, eminent engineer and architect of Westminster. Since coming to Toronto 31 years ago he has been associated with a number of firms in the engineering line. Since 1913 Mr. Wolsey has been secretary and acting registrar of the Ontario Association of Architects.

Something New in Turbine Design

The Turbines for the Great Falls Development of the Manitoba Power Co. are of the Latest High Speed Type—Comparison With the Cedars Rapids Wheels

By H. S. VAN PATTER
Hydraulic Department, Dominion Engineering Works, Ltd., Montreal

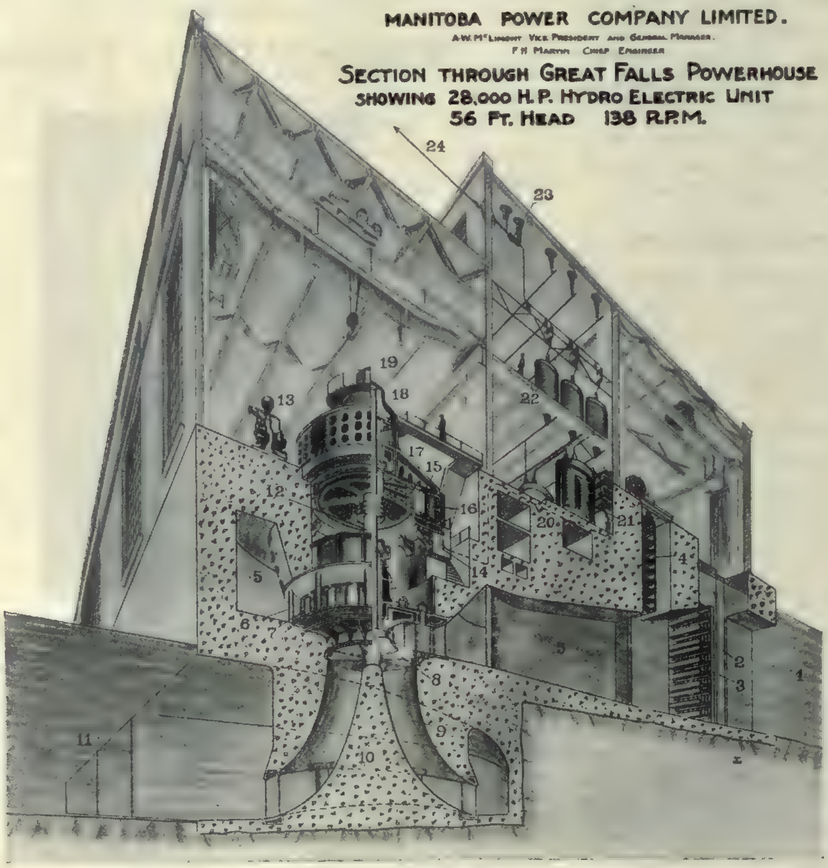
The tendency in the hydro-electric field during recent years has been towards larger and larger turbine units of the vertical-shaft, single-runner type. This has been made possible by the development of the direct connected hydro-electric unit and the satisfactory solution of the thrust bearing problem. With this type of unit, operating under medium and low heads, the question of speed is, for economical reasons, very important. Higher speed means smaller and more efficient generators, lighter overhead construction, and smaller power-house cost. The limit of speed obtainable for large capacity units under low heads has been and still is determined by the limits of turbine development. However, great progress has been made by turbine designers within the last few years, and the most striking example of progress is to be found in the new development of the Manitoba Power Company.

Until quite recently the standard turbine runner for low head installations has been the Francis mixed-flow, i.e., inward and downward-flow type. With this type of runner specific speeds around eighty English units have been in use for some time with high efficiencies. Beyond this point, however, progress has been very slow until the recent development of a new type high speed runner, generally known as the "propeller" type,—its name resulting from the close resemblance it bears to a marine propeller. It has three to six vanes mounted an a central hub, and is usually unshrouded, i.e., there is no surrounding band. The new units at Great Falls are to be equipped with this new propeller type of runner.

Great Falls Turbines

The new 28,000-h.p., units which are being installed by the Manitoba Power Company, will develop this power when operating under a head of 56 feet, at 138.5 r.p.m., as compared with 75 r.p.m., using the type of runner employed in the Cedar Rapids plant of the Montreal Light, Heat and Power consolidated. The units in this plant when installed eight years ago were of the highest speed type then available. The Cedars units, as originally designed, would develop about 27,500 h.p., and the last units installed in that plant about 28,800 h.p., under the higher head of 56 feet, so that a comparison with the Manitoba units is a fair criterion of the relative merits of the types of runners used in the two installations.

The most striking variations from the Cedars


MANITOBA POWER COMPANY LIMITED.
A.W. McLimont Vice President and General Manager.
F.H. Martin Chief Engineer
Section through Great Falls Powerhouse
showing 28,000 H.P. Hydro Electric Unit
56 Ft. Head 138 R.P.M.
24
23
19
18
13
22
17
15
12
16
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10

A sectional view of the power house of the Great Falls development of the Manitoba Power Co.

units lies in the design of runner, speed vanes and draft tubes, and the dimensions of the generator. In this turbine there is a much larger whirl chamber between guide vanes and runner vanes. The runner is of the Moody diagonal type in which, neglecting the whirl velocity as before, the flow is diagonal at intake and axial at exit. The speed of revolution of this runner is remarkable,—the circumferential velocity of the vane tips being about 7,000 feet per minute, nearly twice the spouting velocity of the water for a head of 56 feet. This high speed results in a much smaller generator than for Cedars, the outside diameter of the stator frame being only 24 feet and the flywheel effect of the generator rotor 18,000,000 pounds-feet squared. The higher speed also allows the use of a direct connected exciter, whereas separate waterwheel driven exciters are used in the Cedars plant. There is no solid speed ring for this unit. The speed vanes are cast separately, the ends being imbedded in concrete and anchored by foundation bolts. The draft tube is of the Moody spreading type with central concrete cone running up to the runner, and with supporting cast iron vanes for the surrounding apron.

The propelled type runner is very simple as compared to the Francis type. The outer band is eliminated, and the runner vanes have very little curvature, thus cutting down the liability of corrosion. The number of vanes is only six as compared with sixteen for Cedars. This means much wider space between vanes, and little danger of clogging from ice or debris. The intake racks also may be spaced wider in proportion.

The throat diameter of the Great Falls runner is slightly greater than for Cedars, being 189½ inches, but the overall height is only 4 feet 5¼ inches, as compared with 11 feet 9 inches for Cedars. It is made of case steel in one piece, and the estimated weight is 65,000 pounds, less than half the weight of the Cedars runner. Another advantage of this type of wheel is its great mechanical strength on account ot the longer connection between vanes and hub, and the little overhang of the vanes as compared with the Cedars type. The separate speed vanes furnished with there units represent a new style of construction used here for the first time. These vanes are built in with the forms for the concrete, and securely anchored by long foundation bolts. Lugs are cast on the vanes at the top and fitted with adjusting screws for the proper setting of the pit liner with relation to the draft tube ring. This construction means a considerable saving in material and machine shop labor but, on account of the greater erection cost, it will probably only find application in large units of the type under discussion.

The heaviest casting for this unit is the head cover, which is supported by the pit liner, and in turn supports the lignum vitae bearing for the main shaft. It is built in halves on account of its large size. Its lower surface takes a cone shaped form to conform with the flow lines of the water. The forged steel shaft for this unit is slightly smaller than for Cedars even with the much greater horse-power, its diameter being 24 inches, compared with 25 inches for Cedars. The cast steel guide vanes are the largest yet constructed, their height being 7 feet 1 3/4 inch and width 4 feet 7 inches. They are fitted with separate stems which rotate in bronze bushed bearings in the distributor plate and head cover, and are connected by levers and double acting shearing links to cast iron operating ring. The shearing links are so constructed that in case of any obstruction lodging between two guide vanes when the gates are closing, or guide vane and speed vane when the gates are opening, the connecting link will shear before any damage is done to the rest of the mechanism.

There are other special features of these units which should be mentioned. The guide vane bearings are assured of an ample supply of grease at all times by the use of the Taylor pneumatic greasing system. With this system an air operated grease gun is supplied for each unit with the necessary piping to give a separate lead to each bearing, so that each bearing may be greased independently by a plug cock. The high pressure used ensures adequate lubrication with a minimum of operating labor.

Another feature is the automatic method used for changing from governor control to hand control, or vice versa. This is effected by the use of hydraulically controlled needle valves in the governor pressure and exhaust lines, instead of the old type with gate valves. With the old arrangement two or three men were needed to change the control, but with the new device one man can do so with ease.

The bypass and receiver provided on the governor pressure system is also worthy of mention. This consists of a needle valve discharging a certain quantity of water at all times into a cylindrical receiver connected with the sump tank. The object of this device is to allow constant operation of the pumps without overheating. There is circulation of water through the pumps at all times and the pressure rise is considerably less on account of this bypass.

The total weight of one of these turbines, exclusive of draft tube vanes, governing mechanisms and pumping system, is about 630,000 pounds. This reduction in weight from the Cedars unit is largely due to the new type of runner and the separate speed vanes.

Special Type of Draft Tube

Of late years there has been a growing realization of the importance of draft tube design, particularly for low heads where the velocity head at discharge from the runner is a large percentage of the total head on the plant. For the Great Falls units this percentage is about 30 at full gate, assuming an angle of whirl of 30 degrees, so it is at once evident that an efficient draft tube is highly important. The spreading type of tube with central cone, as developed by Lewis Moody of the Wm. Cramp and Sons Ship and Engine Building Company, is being installed for these units. This tube is constructed on the principle of an inverted vortex. You all have noticed the action of water flowing out through a hole in the bottom of a circular basin, how the velocity of whirl increases rapidly towards the centre, and how the surface takes a curve form with a central space running down through the orifice. The action of the water flowing through the Moody tube is just the reverse of this vortex flow. Both the axial and whirl components of velocity are gained as the water moves down the tube until the lower velocity permits the turning of the water towards the tail race without undue loss. The ability of this tube to regain the whirl components of velocity gives it a decided advantage over most other types. The central cone conforms to the natural flow lines of the water, as determined by the outer surface of the tube, and eliminates the tendency to form a central vacuum, which would cause upward eddies in the portion of the tube and loss in efficiency.

The question of unit spacing and depth of excavation allowable, are important factors in determining the exact shape of draft tube and water passages. In this installation the unit spacing is somewhat restricted so that the depth of draft tube and surrounding water passages is greater in proportion. The overhanging apron is supported underneath by eight cast iron draft tube vanes. These vanes are so shaped as to assist in turning the outflowing water towards the tail race. They are designed to support the total superimposed weight of turbine, generator, concrete and water in the casing. Their use means a great saving in the cost of concrete reinforcing.

Difficult Problem to be Met on the Victoria, B. C. Waterworks

Adequate Provision for Expansion and Contraction Not Made in 48 inch Concrete Main—A Special Band Designed to Overcome the Difficulty

By J. B. HOLDCROFT, A.M.E.I.C.

One of the principal features of the waterworks system of Victoria B. C. is a 48" concrete flow-line main, with a number of inverted syphons in which the same material has been used. This main has given a great deal of trouble from the time of its installation, due to the fact that adequate provision was not made for expansion and contraction due to changes of temperature. The main in question is twenty-four miles in length, and it is estimated that a total change in length due to temperature amounting to as much as 47 feet takes place, and at the best of times at least 30 per cent. of the water carried is lost, while this amount is greatly exceeded during the cold season when the contraction is greatest.

Mr. F. M. Preston, the present city engineer and water commissioner of Victoria, who inherited this problem on taking office some years ago, has carried out a number of experiments with a view to finding a satisfactory and sufficient economical method of making good the many leaks that have developed. The pipe, it may be stated, was manufactured in sections four feet in length and subsequently jointed in place by the original lock-joint system. The problem therefore has been to develop a joint covering that will be watertight and at the same time allow for the inevitable movements of the pipe during temperature changes.

Theoretically, the movement that should be allowed for would be about one fifteenth of an inch at each joint. But as everyone who has had to do with such matters is well aware, it is impracticable to place dependence upon theory in cases of this kind, as inequalities and roughnesses in the foundations or pipe supports will certainly tend to concentrate the movement at certain particular joints, rather than distributing it over all as might be expected. This has been the case in the present instance, and it has been found that bad joints with considerable movement occur at interval of roughly one hundred feet.

Supposing the entire movement to be concentrated at those intervals would give a maximum movement of one-half inch, and while it would be exceeding difficult to design a collar within the limits of economy which would give as much movement as this, the design finally evolved, it is expected, will have a good degree of elasticity and minimize the spreading of the trouble. The band consists of a strip of 24 ounce copper about 6¼ inches in width, of which the middle is being rolled down to a V form, as shown on the subjoined sketch. The V will be turned inwards, and a portion of the concrete at the joint will be chipped out to make room for it, the space being filled with a tar mixture of such consistency as to retain its plasticity at all temperatures likely to be experienced.

It is anticipated that the cost of installing these bands will total about $12.00 each. One hundred and fifteen have been ordered to commence with, and additional quantities will be installed when trial under service conditions has proved the design to be finally satisfactory.

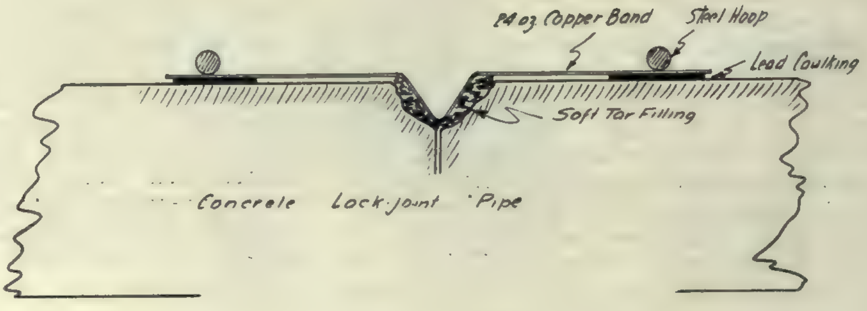


Diagram of proposed expansion joint, Snooke Lake Waterworks, Victoria, B.C. Cross-section of band on longitudinal section of pipe.

Developments in British Excavating Machines

Details of Equipment that is Being Widely Used in the Old Country

Much progress has been made with the steam excavator, commonly known as the steam navvy. Up to a comparatively recent date, contractors had practically a monopoly in the use of these machines for public works such as railways, canals, and docks, but now more excavators are used in open mines and quarries, in more or less permanent situations, than for contract work. The change is due partly to the difficulties of the quarry owner as regards labor and the necessity for keeping costs down under present-day competition, but also to the introduction of machines more applicable to his special working conditions.

The original steam navvy, which was capable of swinging or slewing its excavating gear through a little more than half a circle, has been now displaced to a large extent by the full circle machine, commonly known as the steam-crane navvy, and developments of this latter type are what the quarry owner and general user find so useful for their work.

The size of machine suitable for various workings is governed chiefly by:

(a) The nature of the material, and

(b) The output required per day.

The former will determine the minimum cutting effort to be used. For example: 4 tons to 6 tons is suitable for material up to clay of medium hardness; 8 tons to 10 tons is suitable for stiff clay; 12 tons to 20 tons is suitable for boulder clay; 20 tons to 30 tons is suitable for heavier material, such as limestone and heavy ron ore.

The output pepends also upon the size of the bucket, which again is governed by the nature of the material to be excavated; thus a machine having 6 ton cutting effort is most efficient when fitted with a bucket of 3/4 to 1 cu. yd. capacity; if 12 tons, then the bucket should hold from 1½ to 2 cu. yd. and if 20 tons, from 2½ to 3½ cu. yd., to give approximate examples.

Type of Steam Shovel Most Generally Used

The machines in most general use, weighs 55 tons net or 62 tons in working order. The machine is capable of dealing with from: 120 cu. yd. to 150 cu. yd. of ordinary soil or light clay per hour; 1,000 cu. yd. to 1,200 cu. yd. of stiff clay per hour; 60 cu. yd. to 100 cu. yd. of limestone per hour; 60 cu. yd. to 80 cu. yd. of loose limestone ptr hour.

The following is a fair average of the working costs per cubic yards loaded into wagons.

	Per hour.	
	s.	d.
One driver	2	0
One craneman	1	3
One fireman	1	0
Four men around the machine	5	0
3 cwts. to 4 cwts. of coal	5	6
Oil and stores	0	9
Total	15	6

This represents a cost of approximately 1½d. per cubic yard for the maximum output of easy material and 3d. for the heavy material.

Combined Steam Shovel and Grab Bucket

Another interesting modification is the combined steam navvy and grab. It is a dual purpose machine, and was designed and built to work in an ironstone quarry from which the amount of ironstone required was only sufficient to keep a steam navvy employed rather less than half its time. Overlaying the iron stone was about 8 ft. of material which had to be taken off before the ironstone could be excavated, and the proposition was that the same machine might be used both to remove the cover or overburden and to dig the ironstone.

The jib of the steam navvy was therefore extended and fitted with a grab to enable it not only to have enough reach to lay bare a sufficient quantity of ironstone, but to discharge the overburden on to the ground from which the ironstone had been removed.

Two hoisting drums are fitted to the main drum shaft, one for use with the steam navvy bucket, and the other for use with the grab. The same hoisting clutch and brake are common to both drums, and they are so arranged that either of the drums can be connected or disconnected at will. When the grab is required to remove the cover, the bucket is fastened back to the underside of the jib and the grabbing drum is connected to the hoisting clutch and brake. After sufficient cover has been removed, as much, in fact, as the machine can reach, the grab is disconnected and the steam navvy drum is engaged. The machine then works as a standard steam navvy and can dig the stone which the grab has uncovered.

Steam Shovel With Extra Long Bucket Arm

Another useful modification is a machine which has an entended jib and bucket arm to enable the excavated material to be discharged 60 ft. from the centre of the machine as compared with the 32 ft. of the standard machine. This was specially designed for open-worked quarries in which the overburden had to be dumped from the bucket, back on to the ground from which the mineral had been removed. The machine will excavate ordinary soil or clay at the rate of 25 cu. yd. to 50 cu. yd. per hour. It is obvious that when the jib is lengthened to the extent described the cutting effort upon the teeth must be considerably less than in the standard navvy, otherwise the machine will not be stable. The bucket must also be diminished correspondingly in size. Consequently the cutting power is reduced in this instance to 7 tons and the bucket has a capacity of 1 1/4 cu. yd.

The discharging radius also governs the depth of cover the machine can deal with. This particular machine, with its 60 ft. discharging centres, will deal with from 15 ft to 20 ft. of cover. If it were required to remove a greater depth than this, a machine with a still longer reach must be used, and if heavier cover than that indicated has to be dealt with, or in larger quantities, a more powerful machine with a larger bucket must be employed. Very large machines of this type are now in operation, weighing upwards of 300 tons in working order, and carrying buckets of 7 cu. yd. capacity, capable of dealing with 200 cu.yd. to 300 cu. yd. of material per hour. Such machines have a discharging radius of 100 ft. They are naturally slower in working than lighter machines, the time taken to make a complete cycle of operations being from 50 secs. to 65 secs.

Steam Shovel Working in Conjunction With Transporter

As alternative to the long jib-crane navvy for removing and dumping quarry overburden direct, is an excavator with a normal length of jib, working in conjunction with a transporter, for taking away the excavated material and dumping it. The navvy itself is exactly similar to the one described at first, and stands upon mineral.

The transporter travels in the bottom of the quarry and consists of an underframe and tower, supporting a double cantilever track for the wagon or skip. This underframe is fitted with the necessary wheels and traveling gear which enable it to be moved about the quarry under its own power, and on the underframe are the boiler and winding engines for actuating the transporting gear, which are sufficiently large to haul a fully loaded skip up the inclined track at a speed to suit the excavator, and, in addition, supplying the power for traveling. The skip is about 25 per cent larger than the excavator bucket to avoid spillage. It is fitted with a hinged door simliar in principle to the bucket of the digger, but arranged so that it can be opened at any desired point along the transporter track by means of a movable tripping jack, which is traversed by a small hand winch on the transporter, within easy reach of the driver.

The transporter wagon makes a round trip in 25 seconds, which is several seconds quicker than the average cycle of operations on the excavator, so as to avoid the latter having to wait for the transporter. It really follows the axiom of the ideal contractor, who should arrange his wagon service so that his steam navvy never waits for empties. An output of 80 cu.yd. to 120 cu. yd. of ordinary material can be obtained per hour.

Combined Excavator and Transporter

The machine is a single-bucket excavator carrying a wagon transporter supported by a common tower and main frame, and weighs about 85 tons. The method of discharging the material into the wagon is its most novel feature, as, instead of the bucket being swung round over the wagon in the usual way, the hoisting is continued after the cut is finished, until the bucket is pulled right into the jib and immediately over the top of a chute fitted between the sides of the jib.

Just as the bucket is coming over the mouth of the chute, the catch holding the door in place is mechanically pulled off, the door falls and the contents of the bucket are discharged down the chute into the wagon standing on the transporter track at the foot of the chute. The excavating gear only swings through a little more than half a circle, and the bottom centre of the chute coincides with the slewing centre of the machine, so that the wagon, when lowered down as far as it will go, is also immediately over the slewing centre, and it, therefore always correctly placed, irrespective of the position of the jib. The underframe of the machine is triangular in plan and is fitted with three bogies, one at the front immediately under the slewing centre, the other two at each end of the underframe at the dumping side. The platform of the underframe supports the tower and carries the boiler, transporter engines, and a separate set of self-contained engines for slewing. The main hoisting or digging engines are mounted upon an upper storey of the tower and above the track of the transporter. The bucket has a capacity of 2 cu.yd. Two men are sufficient to operate the various motions, one the driver of the transporter engines, who also attends to the firing of the boiler, and another who controls the excavating mechanism. The machine can complete a cycle of operations in 20 seconds, and is capable of an output of 60 cu.yd. to 80 cu. yd. of heavy clay per hour.

Endless Bucket Excavator Combined with Belt Conveyor

When the material is light and easy to dig, the endless-bucket type of excavator, feeding on to a belt-conveyor may be a very useful and efficient combination, one machine of this kind is operated electrically by three-phase current. It is capable of an output of 80 cu.yd. to 150 cu.yd. per hour, and was designed to remove 50 ft. of overburden consisting of sand, peat and gravel. The bucket ladder is approximately 100 ft. long, and the conveyor 130 ft. long.

Small Steam Shovels

One result of the present-day labor situation is the demand for a small machine, due not only to the high wages which have to be paid, but to the increasing disinclination of men to work with pick and shovel. Previous to the war, hand labor was so cheap that for small outputs there was little margin to cover the charges incidental to the use of machinery; therefore, comparatively few evcavators below 30 tons in weight and 8 tons cutting effort on the teeth were used in this country. Labor conditions have now so altered, however, that brisk manufacturers, quarry owners and small contractors must have something more economical than hand work. In general design and working the machine is similar to the larger machine previously described, but only weighs about 16 tons net, and carries a bucket of 5/8 cu. yd. capacity, with 5 tons cutting effort upon the teeth.

It will deal with any class of material up to fairly stiff clay, in quantities up to 50 cu. yd. per hour; in fact, in many places, such as brickworks, an output of 6 cu. yd. to 7 cu. yd. per hour may be all that is required, and quite a number of machines are replacing hand labor even for this small output. For the maximum output, tw omen upon the machine and two or three around can be usefully employed, but for small outputs one man upon the machine and one or two around it are sufficient.

A modification of this small machine is used for loading coke from a level-coke-oven bench. Instead of being fitted with the usual steam navvy bucket, it carries a large fork, 4 ft. 6 in. wide, arranged with tines similar to a hand fork. The racking motion for regulating the stroke of the bucket-arm is also differently arranged, as instead of the point of suspension being fixed and the working length of the arm varied, as in the case of the steam navves previously described, the length of working radius of the arm is fixed, and the suspension point is raked in or out horizontally. This enables the fork to be thrust along the bench underneath the coke so as to avoid breaking it.

The Materials Market

Steel prices continue to ascend, the following advances having taken place during the past week in the Toronto district: Plates, 1/4-in. and heavier, from $3.00 to $3.25; 3/16-in., from $3.40 to $3.60; 10-gauge, from $4.00 to $4.15; black sheets, 28 gauge, from $4.80 to $4.95; galvanized sheets, 28 gauge, from $6.20 to $6.45, and rivets from $5.50 to $5.75. This item, however, was the only one in the building supplies market that showed a change.

Vancouver's Water Supply Problems

Shortage Has Been Experienced—Commission to Control Supply is Suggested—The Installation of Storage Facilities Would Insure a Steady Supply

The unusually dry summer which is being experienced on the Pacific Coast is bringing home very forcibly to the residents of Vancouver, B. C. and the surrounding municipalities the need of making adequate provision for the future in the matter of water supply. An actual shortage has been experienced, and severe restrictions have been imposed regulating the use of water for the sprinkling of lawns and gardens. This is not due to any actual shortage of water at the sources, but chiefly to inadequacies in the mains and distribution systems due to the rapid growth in the population of the district served.

A peculiarity of the water situation at Vancouver is that practically all the water used by the city and suburbs, which are located on a peninsula between Burrard Inlet and the Fraser River, is brought across from the north shore of the Inlet by a series of submerged mains. This feature naturally adds greatly to the cost of making additions to the capacity of the mains, but a good deal of work is also required, it is understood, within the city itself, if the need of the suburban mrnicipalities are to be properly met.

Commission Control Suggested

At a recent conference of all the parties interested, facts and figures covering the situation were presented by E. A. Cleveland, provincial comptroller of water rights, who, however, made clear that he was speaking more in his capacity as a rate payer of Greater Vancouver than as a public official. Mr. Cleveland strongly advocated the formation of a commission to control the water supply of Vancouver and district. The experiences of the last few years had fully demonstrated the necessity of united control, he claimed, stating that he did not see how the city could undertake to supply a specified quantity of water to any municipality in view of the fact that for years past the ratepayers had, with the exception of last year, turned down by-laws to raise money for development work. He mentioned the experiences of Winnipeg in this connection and said that after the commission system was adopted there the assent of the voters was not required for the financing of necessary work.

It is very difficult, proceeded Mr. Cleveland, to get any reasonable idea of the quantity of water the city is really using, as there is no accurate way of measuring it. There are no meters on any of the mains coming into the city. In 1917 the flow of Capilano and Seymour Creeks was found to be 30,000,000 gallons. Allowing 4,000,000 gallons for waste and 3,200,000 gallons for the municipalities, there was 22,800,000 gallons coming to the city. The average rate of the yearly increase in the number of services in the city is 16 per cent.

Using these figures as a basis, Mr. Cleveland showed that by 1925, if not before, the natural increase in demand would bring the daily consumption up to 33,500,000 gallons, and that without making allowance for any waste the present mains would have to be working to their fullest capacity to supply this amount. Storage facilities would have to be increased to carry the city over the period of maximum daily use in the summer.

How Supply Might be Increased

The water supply is obtained from the two creeks mentioned above, both of which are mountain creeks with a very large winter flow which drops off very heavily in the summer time. Storage on the Capilano, however, Mr. Cleveland did not think would be economically justified, and would prove to be the most expensive storage system which could be undertaken. He thought, however, that the Seymour could be controlled and a storage basin constructed which would regulate the flow to 230 cubic feet per second and insure a supply of 124,000,000 gallons per day. This should supply one million people, but not at the rate Vancouver is using water to-day.

The Contractor and Engineer

By Harold Thackray in "The Constructor"

There is a recent movement to secure closer relations between the engineer and the contractor. The closer the co-operation, and the better the contractor and the engineer understand each others' problems, the more satisfactory the finished product will be, and, finally, the less the contractor will be forced to bid to cover the uncertainties due to the acts of God and the engineer.

There are two sides to every question. A young engineer just graduated from college is very likely to consider that the only way to handle a construction job is to see that the contractor conforms, in every detail, to the plans and specifications, with no regard whatever for the changes and modifications that are necessary to make the application of the plans practical. On the other hand, the contractor is very apt, unless he has had long experience and is honestly trying to get a satisfactory product, to disregard the intent of the plans in order to save a little time or money. Neither of these attitudes are conducive to good construction work.

Broaden Engineers' Education

There have been many articles published recently condemning the technical schools for the narrow viewpoint the technical graduate holds when he first emerges from the influence of the classroom. Only a short time ago, at a meeting of the deans of the technical schools, a program was outlined to lengthen the period of education of the engineer, the extra time to be used to give the engineering aspirant a knowledge of cultural studies and business economics that has been impossible with the high standard that the technical courses have been required to maintain. This is the first step in the right direction.

It has long been the custom of practicing engineers to place the recent graduate on a job as the inspector. As a result, the first training the embryo engineer receives is without immediate or adequate supervision and gives him a great deal of responsibility. Not having had the practical experience necessary for efficient prosecution of construction work, he may get the idea that the contractor is trying to resort to sharp practices and become suspicious. Unless he is usually more than well balanced, he is not competent to distinguish between practical and theoretical methods of prosecution of the work.

Specifications Not a Text Book

One thing that a young engineer is quite likely to overlook, is that a set of specifications is to be used as a guide and not as a text book. Specifications are written airtight, or should be, in order to protect the quality of the work performed, and to give the owner, who is paying the bills, protection from unscrupulous or careless workmanship. They are primarily intended to serve as a guide to the general conduct of the work and are written to cover the most drastic conditions that may be expected to arise; but must be used with judgment and the full penalty exacted only as a last resort.

The contractor who is honestly trying to do a workmanlike job should be given the full benefit of every doubt. He has a great deal at stake, and small delays due to over-zealous inspection not only cause him unnecessary expense but tend to disrupt the efficiency of his organization, with the consequent lowering of the standard of workmanship on the subsequent part of the work. On the other hand, if the contractor continually tries to cover up mistakes or intentionally lowers the quality of materials used, the sooner he is put off the job and "busted" the better for everyone, including the reliable contractors.

See the Other Fellow's Side

Mutual co-operation is the only way to obtain a good piece of work. The engineer inspector must be able to recognize that a contractor is entitled to profit on every contract if consistent with good workmanship. On the other hand, the contractor must recognize that the engineer has a responsible duty to perform. A frank discussion, with the successful completion of the job always as the ultimate object, will be beneficial, but there must be present the spirit of co-operation and the desire to see the other fellow's side.

Simple Method of Planning and Supervising Construction

In all construction work success depends as much upon the executive abilty of the superintendent as upon his technical knowledge. Before any men or materials are moved to the scene of operations, the following points should receive most careful attention by the contractor who has undertaken to perform the work.

The ideal to be aimed at is that when the work has been commenced it should be carried through to completion without any stops or delays. In order to accomplish this, the planning may be arranged in groups as follows:

(1) The preparation of an accurate estimate of the materials required.

(2) Arrangements for transporting the materials to the points where they are required at the proper time.

(3) The preparation of a program of the order in which the work shall be carried out.

(4) An estimate of the labor required for each part of the work.

(5) A review of the operation in order to forestall any difficulties which may arise when the work is in hand.

Group No. 1, may be easily calculated by any of the well-known methods of making estimates, with the exception of the use of empirical formulae in making up tables of quantities. Empirical formulae should only be used when the contractor has compiled a very extensive series of figures which are the results of actual observation on several contracts already performed, and even when these old figures are available it is very much safer to make up an entirely new estimate from the plans and then use the old figures as a means of checking the new estimate.

In Group No. 2 it will be seen that two distinct points are taken up: first, the transporting of materials to the points where they are desired, and, second, the timing of the arrival of the materials so that they will arrive at the work only a very short time before they will be used. For example, in the case of a structural steel bridge it will be quite apparent that it is uneconomical to have the structural steel arrive on the job, any great length of time before the estimated date for the completion of the abutments and piers.

In the case of Group No. 3, if road building is taken for an example, it will be seen that it may be advantageous to finish some fraction of the work in entirety, say the first quarter, and so have the use of that part of the road while the remainder is being built, rather than to finish all the drainage structures first, and then do all the grading and finally all the surfacing.

In Group No. 4, an estimate of labor required for each part of the work can be made accurately only when it is based on careful time studies of the work done in previous contracts. If the contractor has had no previous experience in the kind of work required, he will find it well worth his time to make very careful time studies on the first work of that particular kind which he has undertaken to perform.

The laborers should be divided into gangs and the gangs alloted to specific tasks, the number of men in a gang depending on the task to which that particular gang is alloted.

In an emergency, men can work twelve hours at a stretch. If required for longer periods, they can work in alternate shifts of eight hours for two days. Beyond this time men can only work efficiently eight hours on and sixteen hours off.

The sequence of the several operations of the work having been settled, successful organization of the working party depends on the proper sub-division into gangs. Each gang will be composed of such mechanics and laborers as may be required for their portion of the work, and will be placed under a competent foreman, who is responsible to the superintendent in charge of the work for his gang.

By this arrangement the superintendent is able to exercise general control over the whole work, and make such deviations from the original plan as he deems fit to meet emergencies as they occur.

He is thus able, as in Group 5, to forestall any great or small difficulties which may be met with when the work is actually going ahead.

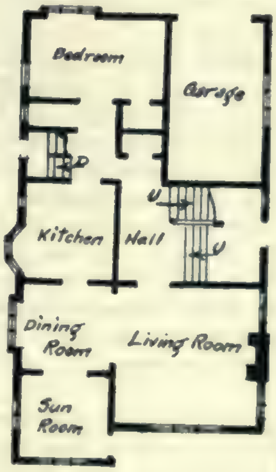
The Contract Record's

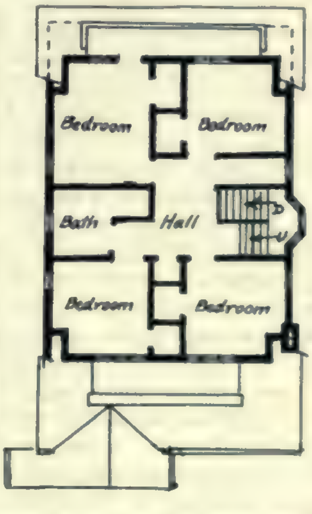
Weekly House Suggestion No. 36

The residence we illustrate this week is one of the most handsome in the Beach District of Toronto. It has just been completed and was especially designed for its ideal location, which is in a beautiful grove of birch trees, on an elevation immediately overlooking the lake. The exterior walls are of light buff stucco, rough finish, on brick to the second floor and on metal lath above, with stone foundations and trim on entrance ways, chimney, etc. As seen in the illustration, the stonework has been carried up in an irregular line over the sunroom windows and over the arched entrance to the side terrace, adding to the artistic appearance of the front exterior. The exterior woodwork in the gables and around window openings, etc., is stained brown, as is the wooden shingle roofing. The window sash are finished on the outside in grey enamel. The terrace along the front and sides of the house is laid with vari-colored flagstones and there is a small sunken pool in this terrace at the front. The entrance on the right side is artistically carried out with suspended canopy and a short secton of stone wall, about 3 ft. high, opposite the doorway. The interior is abundantly supplied with natural light through many various-sized window openings on all sides of the house. The garage is built in at the rear of the house, as seen on reproduced plan, and is reached by a short curved driveway from Silver Birch Ave., to the left.

The entrance from the front terrace is on the sunroom, which is laid with red quarry tile and the walls of which are finished in a buff interior stucco, blocked off to imitate stone. There is an entrance through double French doors from this room to the dining room, which is combined with the beautiful large living room on the right. The latter room contains a handsome brick fireplace, with tile base, in the east wall. The kitchen is situated immediately next and convenient to the dining room, has a terrazzo floor and is finished throughout in grey enamel and black hardware. It contains built-in refrigerator, with provision for icing from the outside, built-in ironing board, enclosed opening to clothes chute, (the top of which has been utilized as a base for an electric range, a space conserving feature), and the usual cupboard space. To the rear of the living room is a large square hall, in which is situated the main staircase. Immediately inside the entrance from the side is a small cloakroom at the right, under the staircase. The flooring in this hall, as in the sunroom, is of red quarry tile to the three wide steps up, seen on plan, which are of quarter-cut oak. There is another square hallway to the rear of the kitchen, with entrance from the left side of the house. In this hallway are located a staircase to the basement, washroom and toilet and a linen closet. Behind this again are located a bedroom and the garage. The walls of both stair wells are carried out the same as in the sunroom, that is, blocked off in buff stucco to imitate stone. The ceilings throughout the ground floor, with the exception of the kitchen, are of course interior stucco and the main staircase and floors, with the exceptions mentioned, are of quarter-cut oak. The cross beams in the dining room and living room ceilings, as indicated on plan herewith, are of hand-hewn fir timber and the woodwork is of white oak, hand rubbed to give an antique Old English finish, all stained a dull brown.

There are four large bedrooms on the second floor, the woodwork of which is clear pine, finished in an ivory tone. The doors and trim in the hallway are of fir. There is an entrance from the left rear bedroom on a balcony. The bathroom is located directly opposite the head of the staircase, has a composition floor and walls of tile to a height of about 5 feet. The built-in shower, indicated on plan herewith, is completely enclosed in white tile. The floors throughout the bedrooms and hall are of quarter-cut oak.





There is a full-sized basement, a section of which, at the front, is divided off and fitted up as a den. The balance is separated into workroom, laundry, coal and fruit storage space and boiler room. The heating plant is of the hot water type, oil burning.

Mr. H. Addison Johnston, 13 Silver Birch Ave., Toronto, is the designer and builder of this beautiful home.

Mainly Constructional

East and West—From Coast to Coast

The Canadian Pipe Company, Vancouver, B. C., are contemplating the erection of a new wood pipe factory which will cost $35,000. The old plant was recently destroyed by fire.

The G. A. Tingley Estate, at Moncton, N. B., has offered a free site for the location of the proposed new university in that province. The site consists of seventy-five acres of land at Leger's Corner, about a mile from the city.

Ford Company of Canada, Ltd., Ford, Ont., are preparing plans for the erection of a new automobile plant on Danforth Ave., Toronto. The building will cover five acres and the dimensions will be approximately 400 x 500 ft.

An announcement made recently by Premier Taschereau of Quebec is to the effect that municipalities will be discharged from any obligations towards the upkeep of provincial and regional highways in the government's new road policy.

Messrs. McDougall & McNeill, Ltd., of Vancouver and Calgary, have secured the contract for the construction of the first unit of a large plant for the Wigwam Pulp & Paper Co., near Elko, B. C. This includes the construction of a power dam on the Elko river, which will store water enough to provide 25,000 horse-power.

The sum of $201,640.88, one-third of British Columbia's motor taxes for the fiscal year 1921-22 is being distributed among the municipalities of the province for expenditure on road construction and maintenance, according to the provincial law in this connection. Vancouver's share of this sum is $59,604.84 and Victoria's $19,692.67.

It has been predicted that the water supply of Capilano and Seymour Creek will by 1925 be inadequate to supply the water demands of the district of Greater Vancouver, if the present rate of growth prevails. The various councils in this district have been asked to submit proposals to the Vancouver city council for a united and permanent system.

The new international bridge between Edmunston, N. B. and Madawaska, Maine, was officially opened a few days ago. The ceremony was carried out by Hon. Pius Michaud, representing New Brunswick, and W. R. Shaw, Attorney-General of Maine, acting in the place of Governor Baxter. The weather was extremely favorable for the event and about 15,000 people witnessed the opening.

Mr. V. Denis, B. A. Sc., until lately Assistant Engineer, Department of Public Works at Ottawa, has just been promoted to the position of Senior Assistant to the District Engineer at Montreal. Mr. Denis, who has made a specialty of bridge work, has been given the charge of designing the plans in connection with the bridges at Isle Perrot, between St. Anne and Vaudreuil, the building of which is to be started this fall.

The week of October 2 has been decided upon as Fire Prevention week throughout Canada, and preparations are being made at many points for an active campaign of education for fire prevention. This campaign will be carried on largely in the schools and a great deal of literature is being prepared for distribution. During the past decade, it is pointed out, more than 3,000 lives have been lost and insurable property valued in excess of $250,000,000 has been destroyed by fire in Canada.

Mr. E. W. J. Hague, chief health inspector of Winnipeg, was elected to the presidency of the Sanitary Inspectors' Association of Canada at the concluding session of their convention in Winnipeg recently. Mr. Alex. Officer, tenement inspector for the city, was re-elected as secretary-treasurer for the tenth successive term. Honorary life memberships were bestowed upon Dr. R. W. Bell, of Toronto, and Mr. J. Murray, director of the division of sanitation for Saskatchewan. Calgary was selected as the convention city for 1923.

There is a movement on foot among the smaller municipalities of the province of Ontario to form an organization for the purpose of interesting the industries entering Canada from United States and Great Britain every year in the possibilities of some of the smaller towns in the province. The scheme decided on at a recent meeting of interested parties at the King Edward Hotel, Toronto, was to organize for the present in districts, the ultimate object being a provincial body. Several committees of two were formed to organize the various districts.

Edmonton is experiencing one of the busiest building years on record, as a glance at the following list of larger structures, at present under construction, indicates:—New public library, $150,000; Kitchen block, $60,000; Mercer block, $20,000; McFarland building, $50,000; Strathcona hospital (to be commenced soon), $125,000; Misericordia hospital, $250,000; McDougall & Secord building, $30,000; Jas. McDougall building, $18,000; Millwood block, $10,000; Andrew's market, $15,000; new isolation hospital (to be commenced soon), $100,000; Calder shops, $200,000; home for feeble-minded, $250,000.

Personal

Mr. S. L. Squires, chairman of the executive, Canadian Good Roads Association, is at present in the Maritime provinces on association business.

Mr. G. O. Macpherson, late of the estimating staff of the John V. Gray Construction Company, has accepted a position in charge of estimates and costs, with Mr. E. J. Curry, plastering contractor, of Toronto.

Mr. Frank A. McArthur, who recently resigned as city engineer of Guelph, Ont., will devote all his time in future to managing the affairs of the McArthur Engineering Construction Company of that city. Business has increased to such an extent recently that Mr. McArthur finds it necessary to devote all his time to the interests of the firm. Mr. McArthur is an honor graduate of Queen's University and first came to Guelph in 1907, later going to Yorkton, Sask., and Regina, and coming back to Guelph in 1915.

Obituary

Mr. Wm. James Conkey, building contractor of Vancouver, died at the General Hospital in that city recently after a long illness from an injury to his back sustained two years ago. Deceased was 44 years of age.

Mr. Robert F. West, a public land surveyor of Toronto, died at his home in that city recently aged 63 years. Deceased was born in Orangeville, Ont., and lived there the greatest part of his life, taking up residence in Toronto about a year ago.

Mr. Edouard Gingras, contractor, of Quebec, P. Q., died suddenly in that city recently. Deceased, who was 77 years of age, was in good health one day previous to his death.

Trade Incorporations

Taber-Ford Construction Co., Ltd., with post office address at Toronto, capital $40,000, to carry on a general construction and engineering business.

The capitalization of the British Canadian Marble Company, Ltd., has been increased from $250,000 to $350,000, by government consent.

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada,
reaching Architects, Engineers, Contractors
Municipal Officials, etc.

Published Each Wednesday by
Hugh C. MacLean Publications
LIMITED
THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700
Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES
Canada, Great Britain and British Possessions $3.00. U.S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, September 27, 1922 No. 39

Let Us Keep Things Moving

In our issue of August 30th under the heading "Unbusinesslike Tactics" we made two suggestions regarding the building industry—suggestions that we believed, if followed out, would help materially to keep the industry on the move during the present Autumn and next year and prevent a return to inactivity and unemployment. These suggestions were (1) that, though conditions may justify an increase in prices of building materials it would be better business in the end to forego those increases as long, and to as great an extent, as possible and thus hold the confidence of the public and (2) that it was very necessary to use tact in dealing with the general public so that they should not be discouraged from building; that it was not wise, for example, to dwell upon scarcity of building materials or higher costs and that more progress would be made if the building material supply men would assume an attitude, toward the public, of confidence. In this connection the coal dealer was cited as a man who, in spite of an absolutely critical situation, had so far succeeded in maintaining the confidence of his customers, largely by putting on a bold front himself.

We are pleased that the two ideas advanced in this editorial appear to have met the general approval of our readers, some of whom have quite enthusiastically endorsed the suggestions. We hear, however, of one interpretation being read into it that never entered the thought of the writer and, has no support, we believe, except by isolating a single paragraph. In order to illustrate our suggestion that less tact in dealing with customers was sometimes used than might be desirable—by some material supply dealers—the writer mentioned a fact that had come to his attention a few days before and it happened to refer to brick. This was the merest coincidence and did not contain the slightest suggestion either that brick manufacturers, individually or collectively, were increasing their prices more than manufacturers of other building materials or that treatment of their customers was less diplomatic. As a matter of fact it is common knowledge that although conditions may justify an increase, the price of brick has been advanced very little—not at all in some quarters—and that probably no class of manufacturer has tried harder to hew as close as possible to the line of actual costs.

The present conditions in the building industry are fairly satisfactory but continued activity is not by any means absolutely assured. We feel confident, however, that a little more careful "nursing" will take us over the peak. This coming Autumn and Winter will be a trying period. Let us all hold on for a few months longer. Nineteen twenty-three, if no unforseen calamity drops on us, should see general conditions so far improved that we can again begin to figure business at a fair profit.

Business Conditions

"The foremost question of the moment is whether the remarkable activity of the midsummer months will be followed by a period of gradually and conservatively increased business or whether it is the forerunner of a period of secondary inflation. The indications point clearly to the conclusion that good business based primarily on domestic requirements is ahead for the autumn months but that inflation in the generally accepted sense will not occur.

Manufacture is on a satisfactory basis, excepting in so far as some industries have suffered from lack of coal and inadequate transportation facilities. Crop yields are excellent for practically all crops except cotton, according to the September estimates, and the forecast is for a cotton crop more than two million bales above that of last year. Unemployment is practically non-existent. Retail and wholesale business in the United States during the autumn will show considerable expansion over that of the corresponding period of 1921.

It must nevertheless be recognized that even though crops are large, dollar wheat, a considerable decline in the price of hogs since the first of June, and relatively low prices of other agricultural products have reduced the purchasing power of the farmer. The situation is similiar in respect to other important classes of raw materials. These conditions and the fact that not far from one million men were continuously out of work as a result of strikes during part of the summer, are major factors which have effectively blocked inflation at this time. Business is being booked for requirements of the immediate future and forward buying is cautious. Good business is assured but it is not reasonable to expect a boom".—Commerce Monthly.

These remarks would appear to apply in a very large measure in Canada. In many ways we are in a better position than our neighbors to the South.—e.g. we have had no serious strikes, the unemployment situation has been steadily improving and consequently the buying power of the general public is increasing; the western crop reports indicate almost a record crop, and though the farmers need not expect war rates for their products, the indications are that prices will improve—though they already compare favorably with pre war figures. Improving business seems assured. We need not expect a boom, nor would it be good for us.

The Business Papers' Influence

Press Day has become an established feature of the Canadian National Exhibition and the luncheon addresses are notable for the valuable information they invariably impart. At this year's luncheon, Mr. H. T. Hunter, vice-president of the Canadian National Newspapers and Periodicals Association, and speaking more especially for the technical and business publications, stressed the importance, to the Exhibition, of the type of publicity afforded by these publications, due to the selected class of readers they reach. He stated that the circulation of business and technical magazines in Canada was approximately four hundred thousand, composed of readers who looked to these publications for much of the information necessary to enable them to conduct their business along profitable lines and who consequently scrutinized every issue very carefully.

The speaker also referred to the common aims of the Business and Technical Newspapers and of the Canadian National Exhibition. The educational aspect is the most important in each case. Quoting Mr. Hunter, "We are on common ground in educational work. I believe this Exhibition was started primarily for educational purposes and its great success is due to the fact that you have never allowed the amusement side to dominate. I believe the educational features should be given wider publicity. The individual exhibitors do a good deal in this connection but there is much to be done collectively. A few people would come to see a few exhibits of motor cars, but thousands will come when they know there will be seventy exhibitors representing probably 70 per cent of the manufacturers who are seeking Canadian business. In our Association there is a publication for practically every line of business. These publications have told, year by year, the outstanding events of the Exhibition that would be of interest to their readers, and I think we can claim that this has been a factor in increasing interest and attendance of a very desirable class of people."

The further valuable point was emphasized that the exhibition authorities were especially interested in bringing in the men and women who have "a stake in the country—the responsibile people, the people of large buying power," in a word, the class of people who read and study business and technical papers. In every line of endeavor our publications reach a very large percentage of business men and women who have come to regard their trade-papers as business associates.

Mr. Hunter's concluding sentence will meet the hearty approval of all members of the Association. "The publications in our Association will be very glad to co-operate with you, not only in organizing exhibitors and inducing them to guarantee the cost of the buildings, but in making the buildings a success after they are erected by bringing to the Exhibition the class of people these exhibitors want to reach. For, after all, the real success of an Exhibition does not consist in large buildings or elaborate exhibits but in the class of people who attend."

Invest in Dominion Securities

The Minister of Finance is offering, on attractive terms, to exchange Victory Bonds maturing December 1, 1922, for new bonds bearing the same rate of interest and running for a further period of either five or ten years. As an extra inducement a bonus of a full month's interest is given to those accepting the offer which is open until September 30.

The Minister's proposals carry us back to the grim war days of 1917 when these bonds were first put out. Under the impetus of the patriotic appeal and the intensive campaign of the first Victory Loan Organization the issue was successful to a degree that the most optimistic had not dared to anticipate. Literally, hundreds of thousands of Canadians became, for the first time, investors in bonds,—a result of tremendous importance to the country as well as to the investors themselves. Accumulated savings were invested and surplus earnings for many months ahead were pledged, calling for a very practical response to the "Save and Serve" appeal of the then Minister of Finance.

The 1922 maturity was particularly favored by small investors and, even as it was important to Canada that they should have subscribed in the first instance, so is it desirable now from a national as well as a personal standpoint that their investment should continue. It would indeed be regrettable if any considerable number of the holders of bonds subscribed to under these circumstances should pass over the Minister's offer with the idea of using the money at maturity for less sound investments or unnecessary expenditure.

Invested in Dominion securities the money is safe, and the interest return sure and profitable. The Minister makes a generous concession to home investors, as a large issue of Dominion bonds were floated in New York last April at 5 per cent.

It is hoped, and anticipated, that there will be a large percentage of re-investors from the ranks of the small investors who purchased bonds for the first time in 1917.

Trade Incorporations

E. J. Shepard, Limited, with head office at the corner of Belleview and Primrose streets, Hamilton, capital $40,000, to deal in builders' supplies.

The Silica Rock Co. Ltd., with head office at Ottawa capital $85,000, to carry on the business of a quarrying and mining company.

Sinclair Construction Co. Ltd., with head office at Toronto, capital $150,000, to carry on a general contracting business.

The Dominion Fire Brick & Clay Products, Limited, has been reorganized and 25 per cent of the capital stock has been cancelled, reducing the capital to $269,500.

What Should a Road Policy Involve?

Service Is the Main Consideration—The Road Problem Demands the Interest of Able Men Who Will Exercise Sound Judgment in Determining its Solution

By M. A. LYONS

Chief Engineer, Good Roads Board, Province of Manitoba

At the general professional meeting of the E.I.C., Winnipeg, Man.

The roads and highways of any country hold a very unique position. They are entirely devoted to, and can be considered only from, the view point of "service." There is no other reason why there should be roads except to serve the public. Railways serve the public but up to the present they have not been constructed to serve unless there is a hope that they will at least pay their way. Street railways, power systems, telephones systems, water-works and other public utilities are expected to be paid for directly by those who enjoy these utilities; but roads are to be paid for by the public at large and seldom if ever by the people who use them in proportion to services received. In considering a road policy we must always keep before us that the whole aim of our policy must be one which will give the greatest value in service. This service is not for any group of people —not for the farmer alone or for the manufacturer; not for the man with a team or the man with the automobile; not for the worker alone or the pleasure seeker; but service to all who wish to use the road.

Importance of the Road Question

Before giving consideration to some underlying principles in selecting a road policy it may be well to bring out some facts which will emphasize the importance of the road question, and in so doing it will be compared with that utility with which it can best be compared, the railway. Looking up the railway statistics for the year 1919, we see that in that year the railways carried 111,487,780 tons of freight, which cost the owners 273 million dollars in freight charges. The Dominion Commissioner of Highways has estimated that about fifty per cent. of this freight was at one time or another hauled over rural roads, and an analysis of the type of freight which made up this tonnage would bear out this estimate. It must also be kept in mind that there is a large amount of material moved over rural roads which does not reach the railways. It would therefore appear that this estimate is on the low side. The Commissioner also estimates that the average length of haul on rural roads was 7.6 miles and the average cost of hauling at least 35 cents per ton-mile. Allowing 56 million tons moved, we find that the cost of hauling this material on roads was about 149 million dollars or about 54 per cent. of what was spent for freight on the railways. In 1919 the railways carried 48 million passengers at a cost of 96 million dollars and making about 3.6 billion passenger-miles. We have no records of passenger travel on roads and can only estimate again, but we know that in 1921 there were 463,848 automobiles registered in Canada. Allowing an average of two persons per car and that each car travelled 5,000 miles per year we find that automobiles made 4.6 billion passenger-miles, a considerably greater passenger-mileage than the railways. Allowing 10 cents per automobile-mile, we find that the cost of moving passengers on roads was about 232 million dollars, which is greatly in excess of money spent on railway passenger travel. This does not take into account traffic by other vehicles on roads. These figures, while only estimates, show two things—first, that the subject of roads is important enough to warrant a careful study for, and the putting into effect of, a comprehensive road policy; and second, that the amount of service rendered to the public by roads is as great, if not greater, than that rendered by the railways.

Up to the end of 1919 we find the capital invested in railways in Canada to be over two billion dollars. To this must be added the capital expenditure of over 413 million on government railways and nearly 24 million on provincial railways making a total capital of about two and one-half billion dollars. The Dominion Government aided other than government railways to the extent of nearly 222 million dollars; the province over 43 million and municipalities over 16 million. They have had land grants of over 44 million acres and bonds guaranteed to the amount of 344 million dollars. These figures show the value which the public of Canada has placed on this utility which performs a service similar to that performed by the roads, but whose utility and investment would be of no value without the service given by the roads. While the railways perform a service, this service is paid for by the users of the railways and the utility is expected to pay at least interest on the money invested therein. Roads have no opportunity to show a balance sheet and must therefore depend entirely on service for justification of their construction.

Divisions Under Which a Road Policy Should be Considered

The consideration of a road policy falls into two divisions: 1st, executive; 2nd, financial. Under "executive," we must first consider who will have charge of the roads. Will they be constructed and operated privately or by public bodies. This question has already been answered for us and it seldom enters our mind that they could possibly be operated by private corporations in competition with each other, although if they were operated in some such way our highway system would be in much better shape than it is to-day. It had been determined for us that they are to be under the control of some public body. Of these there are in general three bodies, who are in a position to assume this duty; (1) the federal government, (2) the provincial government, (3) the municipal government. To put roads under control of the federal would in some cases probably require changes to the British North America Act.

In a railway, where the haul is inter-provincial, it is essential that one central body should have control of a complete system. In roads it is not essential that there should be one central body in control throughout the Dominion. Freight hauls and passenger travel on roads, on the average, are over short distances as compared with the railways, and a large percentage of both of these originate and terminate within one province. There remain the other two bodies: the provincial and the municipal. The first means one central organization, the second means a large number of small organizations. In order to discuss which type of control would be better let us examine what is required of the road.

Types of Traffic

As the purpose of the road is service, we must know to what type of traffic we render service and what it requires. It is evident that the road must be constructed to suit the traffic, (within reasonable limits), instead of expecting the traffic to suit the road.

The first two divisions to be made are; (1) serving a well developed district and, (2)serving a new district. The traffic in the developed district will be outside or through traffic, and local traffic. The through or outside traffic will consist of strangers to the road and those more or less familiar with the road and will consist nearly all of motor traffic. The local traffic will consist largely of team-drawn loads with some, (and rapidly increasing), motor truck loads, automobile traffic, (mostly of the district), and some light team traffic. The traffic to be served under the heading of "new districts" will be mostly local traffic consisting chiefly of team-drawn loads, and a very light motor traffic.

What service is required by the stranger to the road? If he is a stranger to our country he may be on a tour intending to cover a considerable distance, and will be interested in passing through the country from one city to another along main highways. The impressions which he retains of our country will depend on the enjoyment which he obtains from his trip. He probably will have a schedule laid out which he wishes to follow. To serve him the road must first of all be safe under all conditions. It must be well marked so that he may follow it at anytime with certainty and ease of mind. It must be passable at any time during the travelling season. It must be a fairly direct route from city to city and must connect up with similar roads in adjoining provinces. Road laws must be the same throughout. A similar service is required by the man who is more or less familiar with the road. To this man, safety, directness and passable conditions of the road are more essential as he will undoubtedly be driving more at night than will the stranger; and in many cases a saving in time due to directness of route means actual dollars to him. In addition to the service required by the stranger he will require more highways, reaching more cities and towns. The roads to serve these two classes must be designed primarily for automobile traffic.

What service is required of the road for local traffic? The traffic will consist of team-drawn loads from farm to market, and from town to town; some truck loads mostly from town to town with a chance that there will develop a motor truck traffic from farm to market. There will be auto traffic from farm to town and from town to town partly for pleasure, partly for business. There will be light team traffic, school vans on some roads, and some roads will be mail routes. For team-drawn loads the road surface should be passable in any sort of weather. It should be so that the cost of tansporting the load is a minimum. It should be safe under all conditions; and should be direct. For truck loads it is even more important that the roads be passable at all times. Grades are not so important as for teams but directness of route is more important. Local auto traffic demands a road safe at all times but perhaps, is not so much concerned if the road should not be first class for a few days at a time. School vans demand that the roads be in good condition at all times during the school term and especially is a safe road required for this class of traffic. The postal routes must be safe and passable at all times.

Three Classes of Roads

Summing up for this division of traffic it appears: First, there are three classes of traffic and consequently three classes of roads; (1) "through" traffic requiring "through" roads; (2) town to town traffic; and (3) farm to market traffic. This latter including school van routes and probably postal routes. Summing up the service which each class of traffic requires we see that all require safety; mostly all require that the road be passable at all times; next directness of route; next light grades; and then a well marked route. To all these classes there should be added the pleasure seeker or the man who is out for recreation only and who desires to see the beauty spots of the country. He is interested only in roads which are safe and passable at all times and which run through the prettiest portions of the country.

The requirements in a district being opened are quite different from the older settled district. Auto traffic will be comparatively lighter and team-drawn vehicles will constitute the greater portion of traffic. The total volume of traffic will be light and speed not such an essential item. The road ditches in many cases must serve for draining the country. The service required by a road in this country is such as to justify a much cheaper type of road than in the older districts, but nevertheless it is a very important service which they must render.

So far we have considered roads from the viewpoint of the person who uses the road. We must also consider it from the view of the man who pays for the road. If he is a payer and not a user, in the majority of cases he does not want to spend any money on roads. If he is a payer as well as a user he wants the money spent in the manner to give the maximum value, and he wants to know where and how the money is spent.

Executive Requirements

Having considered the service requirements of the different types of traffic let us see what is required of the executive to provide this service—evidently a competent organization and money. To give the service required by those using the road the organization must consist of men who have knowledge of how to produce the results required, and the man who pays requires that the organization consist of men who can produce the results economically. To quote partly from the Commission of Highways for Canada, the organization must consist of "men who have had the training and experience to meet the problems which arise" and who "have been imbued with the public service idea and the necessity in the public interest of expecting one hundred cents in the dollar in value of workmanship and materials." This organization is expected to be capable of gathering engineering and economic data, correlating it, applying it, and filing it; of looking after the carrying out of construction; and as fully important, if not more so, of looking after maintenance; of seeing and knowing that work is properly done, money properly kept. To do this, the organization must have men of several types of training.

Some of the data to be gathered consists of facts about the amount and type of traffic which now uses the road; facts which will govern the change in volume and type of traffic which will use the road, when it has been improved, and in the future; facts regarding the cost of construction and maintenance of different types of road, the amount and kind of service which they will render under different traffic conditions; engineering data which will enable him to design the proper type of road and bridges to render the service required; facts regarding the cost of construction and maintenance; facts regarding the different methods of carrying out work and the use of different machinery and materials. The gathering of this data requires a man with a sort of training. The keeping of accounts requires another type of training. Men are required with office training for detail office work. The organization of the staff and keeping it running requires a certain type of training, as well as the man who has the general direction of the carrying out of the policy and relating it to the public. Evidently then, men of several different types of training are required for an efficient organization. To give the service which was stated as required by different types of traffic we know that safety requires a smooth, even surface, a proper cross-section, strong culverts and bridges, protection of high fills, and clear view, and for through roads, uniformity. To be passable at all times means generally some type of surfacing and the proper type of surfacing for the traffic. Both of these require immediate, constant and uniform maintenance.

Where Control Should be Placed

With control in one large central body an organization can be constructed of the men with the different types of training required to give the proper service. Continuous safe roads will be constructed, marked and maintained in a uniform manner, Proper machinery can be purchased in larger quantities and at opportune times. Gravel pits and stone quarries can be purchased for present and future use. Work can be planned and arrangements made for carrying it for some time ahead and in proper order. Authority and uniform laws can be authorized by legislation easier to one body than a great variety of laws to a large number of bodies. Arrangements for financing the work can be easier and better made. The cost of the work can be properly placed when it has once been decided how the costs shall be borne. On the other hand the provincial organization offers a greater chance for manipulation by politicians. There is an opportunity in a large organization for a large waste of funds and for over organization. The members of the organization may not take as keen an interest in the work as might members of municipal organizations. Provincial government organizations are generally bound by fair wage schedules in having any work carried out.

Municipal organizations are free of control by provincial politicians. They are more intimately connected with the work and there is less chance of a squandering of funds. There is a probability of a keen interest being taken in the work on account of their intimacy therewith. They are not bound by fair wage schedules but free to obtain labor on an open market at competitive prices. They have intimate knowledge of the local requirements for roads. They can generally get work done cheaper by local labor in small portions than can the larger organizations. On the other hand, they cannot build up an organization of men with the different types of training required. Continuous and uniform roads will not be constructed; each municipality will construct roads according to its idea, often with no regard to continuity and sometimes each councillor will construct his own peculiar type of road in his own ward. One municipality will have safe roads and the next very poor roads. Proper machinery for construction and maintenance cannot always be purchased. Large gravel pits for future use will not likely be reserved. Materials cannot be purchased at such an advantage. Roads will not be as uniformly marked. Raising of money will be more difficult and allotting of costs cannot be so fairly done. Records will not be so well kept.

These are some of the things to be considered in deciding how the roads are to be controlled. There are also several forms of dual control which might be considered. The province to have control of some roads and the municipalities of others. The control might be under the municipality subject to certain control and approval by the province, or vice versa; and all shades and varieties of these dual controls. It would be only under ideal conditions that dual control would work out satisfactorily. After the decision as to who shall have control comes the selection of the organization. Considerable space might be devoted to consideration of this. Once the organiza- is properly formed, a big step towards the success of the road policy has been taken. After this comes the method of construction. The selection of the type of roads and construction is a matter of engineering detail and once the right organization with sufficient authority has been formed, these can be satisfactorily worked out.

Financing of Roads

Coming to the financial question, this might be divided into three heads: (1) How much money should be spent yearly on roads; (2) how it is to be raised; (3) on what basis will the cost be distributed. The answer to the first question is beyond the knowledge of the writer, but it appears that by a proper study of wealth produced in this country, and from a study of value which might be received from good roads, that the maximum and minimum amount which should be spent on roads could be arrived at. This appears to me to be an immense question in itself, involving not only a study of present value which would be received, but also of future benefits which might accrue. This last includes a study of our material resources, probably methods of development as related to roads, and a study and plan of the whole future development of our country. This opens to us a vision of what the road question means when considered in its wide aspects.

The second question has been answered in many ways in different provinces and countries. The money must be raised either, (1) current revenue; (2) term debentures; (3) capital account; (4) a combination of any two or more of these methods. The selection of which method should be used is a study in itself and should be decided by men of training in financial matters who are familiar with the various factors that determine which method should be adopted. The method that would be satisfactory in one section of the country might not be satisfactory in another. If members of a community had the opportunity to loan money in small sums at a higher rate of interest than they could borrow in large sums, it might be better to borrow money for roads. This might be the case in one community and not in another. If money can be borrowed at a time when one bushel of wheat will pay off a dollar, it might be of advantage to borrow. In a new district it might pay to borrow money to improve the roads and open up the country for settlement and the increase in wealth produced might repay several times over the money required to pay back the debt. No attempt will be made here to solve this question but merely point out that the road question is not one of simply pushing up earth with a push grader, but is one requiring the services of men of a variety of training and experience.

The third question, "On what basis will the cost be distributed," offers another field for considerable study in order to arrive at an equitable solution. In most public utilities those using the utility bear the cost; but others besides those using the roads receive benefits. The land owner who has a good road constructed by his land is receiving benefits from the road even if he lives miles away, his farm not under cultivation, and the road never used by him. It seems reasonable that he should share some of the cost of the improvement, and that the whole cost should not be carried by those using the road. If a good road tends to reduce the cost of marketing produce or enables the gardener to get his produce to the consumer in a fresher state surely the consumer is securing some benefits. If a good road enables children to get to school where otherwise they could not, who can place the benefits which may be received from the results of the education of a child which may become the leader in our country.

The first consideration which comes to mind is, should the money be raised and the cost assessed by federal, provincial or municipal governments. It is not clear to my mind why the Dominion government should undertake the financing of road building. The people must pay and they pay no less by paying it through the Dominion organization rather than some other. The sources of Dominion revenue are not directly connected with roads and the public services which are under Dominion control are not directly interested in roads except the postal and military services, so that the raising of money by the federal government appears to have no direct connection with road service nor is the money likely to be spent on roads which directly affect federal services. However, those who are interested in this phase of road financing can undoubtedly supply adequate reasons why the federal government should assist in financing road construction. On the other hand the provincial governments obtain revenue from sources which receive service from roads, such sources as automobile license fees, direct taxes on land values, direct taxes from those who haul loads over the roads. The municipal source of revenue includes direct taxes on land values and on those who are the main users of roads. It would appear to the writer that the financing of road construction should be a function of the provincial and municipal governments.

As the money must be provided by the individual, in the final analysis we must give consideration as to how the cost is to be distributed to the individuals. This might be done on the basis of ability to pay or on the basis of benefits received. While taxation on the basis of ability to pay might be a fair basis for certain government services, it does not appear to be equitable that this should be the only basis on which to secure revenue for road construction. In general, public utilities rendering similar service are paid for on the basis of service received and this appears a fair basis for obtaining a greater portion of the revenues for road construction. Its equitable application is difficult if not impossible. Those receiving most of the direct services are the users of automobiles, motor trucks, farm teams, other team loads, light teams, school vans and mail routes. The majority of automobiles and motor trucks do most of their travelling on certain main highways and town to town roads, but they do some travelling on other roads; farm teams do most of their hauling on market roads but they do some on main highways and town to town roads; the land owner, we saw, received some value; the consumer of products receives some value; and the people at large receive some value. The question is in what proportion do they receive value from good roads. We assumed that the average motorist travelled 5,000 miles per year at a cost of 10 cents per mile. If the good road reduced the cost only ten per cent it would be worth $50. per year to him; but this is away low in the saving which will be effected. In the first place you cannot run a car on poor roads for less than 15 cents per mile; secondly, the saving will be much in excess of ten per cent in the cost of running the car, and thirdly, a saving of still greater value will be made in the saving of the time of the passengers. If automobiles were taxed $50. per year and this money put into proper roads they would, on the average, still be money in pocket. With half this money we would have a yearly road fund of over 11 million dollars from this source alone. We estimated that 56 million tons of freight were hauled over rural roads at a cost of 35 cents per ton-mile. If the cost were reduced to even 30 cents per ton-mile we would effect a saving of over 6 million dollars yearly. The average value of farm land in Canada is estimated at $48. per acre. Suppose good roads were established and the value of land increased by $5. per acre, the interest on this at 6 per cent is 30 cents per year or about 6 mills per acre. Suppose we ask only one-half this value to put into roads or 3 mills. The estimated value of farms and farm buildings in Canada is over 4 billion dollars. A rate of 3 mills would give another 12 million dollars yearly. If we asked each poll to contribute 10 or 15 cents per year for general value received we would add another million to our revenue, making a total yearly revenue of about 30 million dollars. We pay the railways directly over 369 million dollars per year. The point to be brought out is that there are several classes of beneficiaries from good roads; that consideration must be given to arrive at an equitable distribution of costs, mostly on the basis of benefits received; and that when these costs are distributed on this basis each person will be paying only a portion towards the value which he will receive.

It has been possible in this paper to point out only some facts which must be considered in deciding on a road policy. The main things which should be brought out are:

(1) That Service is the first consideration in a road policy.

(2) That the road problem is a large one and worthy of consideration by able men.

(3) That men of a variety of training, of broad experience and sound judgment should be requested to give their assistance in solving the problem of what should be a proper road policy for a country.

Further Reports on the P.G.E. Railway

Col. J. S. Dennis and W. P. Hinton, in Supplementing J. G. Sullivan's Report, Find Little to Offer Encouragement in the British Columbia Railway Situation

By our British Columbia correspondent

Supplementary to the report by J. G. Sullivan, on the engineering and economic features of the Pacific Great Eastern Railway, the British Columbia government has also received reports from Col. J. S. Dennis, on the natural resources of the country tributary to the railway, and from W. P. Hinton, on the organization and operation sides of the question.

Col. Dennis, in his report divides the country into sections roughly corresponding with the divisions of the railway, and for each section briefly discusses future possibilities under the general headings of agricultural land, timber resources, mineral resources, water-powers, tourist resorts, and traffic possibilities.

The first section dealt with is the coast division, which extends from Squamish, the southern terminal, to the old town of Lillooet. There is a certain amount of agricultural land in this section, but the outstanding feature is the large stand of very fine merchantable timber, existing between Squamish and Pemberton, and also the fact that there is a large quantity of timber suitable for pulp. It is noted, however, that all this timber is difficult to log, owing to the steepness of the mountain sides on which the growth occurs, and it would seem that a very considerable proportion of it could be better manufactured on the ground by small mills than hauled as logs over the railway line to tide-water.

There is quite a large area of agricultural land in the vicinity of Lillooet, which, however, requires irrigation. Col. Dennis considers this district suitable for a much more intensive class of agriculture than has been practised so far, and recommends the introduction of a system favoring the cutting up of the land into small holdings, with the production of higher class products.

Mineral resources of the division consist of copper properties, on which little, if any development work has so far been done, certain deposits of iron ore, and some talc deposits which have been worked but are at present inoperative. There seems to be no prospect of immediate development which would meet the need of the railroad for the creation of traffic.

A number of water-powers exist in an undeveloped condition. One or two of these are of considerable size and promise, one especially that at Bridge River, a large development on which preliminary surveys and development work have already been undertaken. A number of attractive tourist resorts are already in existence, and the character of the country is such as to favor further development of this trade.

No Prospect of Increased Traffic

It is concluded from the above considerations that this section of the line does not warrant the expectation of any immediate increase of traffic, and it is noted that the traffic due to timber stands, whether for lumber or pulp purposes, is not of a permanent character, and the district concerned is not as a whole capable of being converted into a traffic producing area of another sort. There is no immediate prospect of development of the natural resources of the district as a whole so as to create traffic sufficient to take care of the heavy fixed charges and expenses of this section of the railway.

The second section considered is that from Lillooet to Williams Lake. This is generally speaking, an irrigation country, with its development further limited by the fact that the water supply for irrigation uses is very limited. There are, however, a number of large ranches, particularly at the north end of the district, where beef cattle, to the extent of about 3,000 head per annum are raised. It is thought that this number is not likely to be greatly increased.

There is nothing remarkable to be noted under any of the other heads—timber and mineral resources are comparatively negligible from the traffic creation viewpoint, and the only likely source of permanent increased traffic and development of a number of the tributary valleys, which is again dependent on the construction of good roads and a certain amount of colonization assistance.

From Williams Lake to Quesnel is a district which already is well developed agriculturally, with bright prospects of further expansion. There are a number of large ranches in the valley of the Fraser River, and opportunities exist for a number of industries at the town of Quesnel to deal with agricultural products and prepare them for shipment. There are no large timber resources, but the world famous Cariboo placer-gold mining district is tributary to the section, and new discoveries which have been made recently may result in a renewal of the old-time activity of the section in this respect.

On the whole it may be said that this portion of the line affords an opportunity for largely increased traffic resulting from agricultural development. The district is capable of supporting a large number of additional settlers, and if actively developed should provide a more intensive local traffic than any other portion of the line to the south.

A Colonization Road

Speaking generally, it would seem that the Pacific Great Eastern Railway must be looked upon purely as a colonization road, and cannot be expected to fulfil any function of through traffic, and as a consequence, considering the fact that the line is now owned by the province, the report recommends that certain activities and large expenditures by the government are necessary to aid in the early development of the natural resources tributary to the line.

Steps should be taken to create a colonization and development of the railway's service. This should be responsible for the preparation and publication of a comprehensive and accurate industrial survey of the country, and subsequent carrying out of plans for development and colonization.

It is further recommended that the government cannot afford to maintain the parallel routes of the Pacific Great Eastern Railway and the Cariboo trunk road, which is the old Cariboo trail of the early mining days. The suggestion is made that portions of this road contiguous to settlements should be maintained as at present and that the long connecting sections which constitute the principal competition to the railway should be put on a toll basis, the receipts from this source being applied to the improvement of the east and west market roads so badly needed to aid in the general development of the country.

The report concludes: "I am forced to the conclusion that while there is the possibility of materially extending the present development of the agricultural, timber and mineral resources, through the medium of government assistance, as outlined above, there is no prospect that traffic can be created as a result of such development, at least for many years to come, sufficient to provide for the heavy fixed charges resulting from the construction, maintenance and operation of this railway line."

Tendency is for Decrease in Revenue

W. P. Hinton, in his report on operation, concludes:—"The operating costs of the North Shore line and the Squamish division to Clinton are so great as to preclude any possibility of net operating revenue. Costs of maintenance and expenditure on capital account must increase. Bridge renewals and repairs outside of capital account will now increase if the factor of mere safety is to be met, at the rate of $250,000 per year, without hope of reducing other maintenance costs. It is hopeless to expect any great increase; in fact, the tendency is for a decrease in revenue over the line between Squamish and Clinton.

"Consequently consideration must be given to the advisability of abandoning the entire line from Squamish to Clinton. In this way the line would be preserved where there are traffic possibilities and operating costs would be normal. It (the proposed connection from Clinton to Ashcroft) would connect the line most effectively with the outside to afford markets on a favorable basis with other competitors, so that colonization and the development of industries would be possible, and furthermore, be the means possibly of making the property more attractive to other railway lines to lease and operate under suitable conditions, thereby relieving the people of the province to a very marked extent of an obligation which must become increasingly and intolerably burdensome.

"There can be no hope of effecting arrangements to relieve the province under present conditions and prospects, but if the connections are effected at Prince George and Ashcroft, the province only retaining the line, if any, north of Squamish until it too can be entirely abandoned, then it should not be difficult to conclude arrangements that would meet with the general approval of the public as constituting a welcome relief from the present burden."

Unprecedented Development is Needed

The three reports are therefore in substantial agreement as to the exceedingly difficult position in which the province of British Columbia stands as owner of this line of railway. Interest payments alone amount to over $5,000 per day, and as pointed out in the Sullivan report, it would take an increase in revenue of over 2,400 per cent. to break even—an increase which evidently cannot be looked for even far in the future unless some unforeseen factor causes an unprecedented development at one or more points along the line. The fact that there are known to be extensive iron ore deposits in the country tributary to the line may prove to be such a factor, taken in conjunction with the recent announcement that several of the largest British firms in the steel industry intend to install and operate blast furnaces in British Columbia.

It does not seem very likely, in any event, that the entire abandonment advocated by J. G. Sullivan will be carried out. A. F. Proctor, chief engineer of the line, estimates that the line from Ashcroft to Clinton could be considerably shortened from the route surveyed, saving eight miles of distance by the introduction of a pusher grade, which would be economically justified. With this alteration, this cut-off could be built for something less than $2,000,000. Mr. Proctor's proposal would be to build this branch, and abandon the line from Pemberton to Clinton, a distance of 110 miles approximately, salvaging this portion of the line to assist with the cost of the new branch, 38 miles in length. The sixty miles from Squamish to Pemberton would then be maintained as a logging road only.

As to the north end of the route, Quesnel should be made the terminus, everything north of there being salvaged as far as possible, and the entire passenger and express and mail service carried on light gasoline motor cars requiring a crew of only two men. Running costs of such cars, said Mr. Proctor, are only about $0.80 per mile compared with a minimum of $2.50 per mile for steam trains. Freight would be carried on steam trains, the service being arranged so that trains would only run with a full load, at least in one direction.

The introduction of the light type of gasoline motor car seems to be the logical answer of the railroads to the inroads being made upon their business by the unorganized fleets of motor freighters which are making increased use of the highways for their business. Many of the shorter roads in the United States are making this change in their methods of operation, especially where there is a substantial volume of local passenger and express traffic requiring great flexibility for economical operation.

The Fletcher Building, Victoria, B.C.

A building which though small is of the best type of fireproof construction, is being erected on Douglas Street, Victoria, B. C., next door to the large Spencer building for Fletcher Bros., musical instrument dealers, and one of the firms burnt out in the fire at the Arcade building some months ago. The building is to have two stories and basement, the foundation walls of concrete being carried up to the level of the road. The construction above this is of steel, with concrete floors and brick curtain walls, while the roof will be of the ordinary tar and gravel finish.

Steel erection on the Fletcher Building, Victoria, B.C.

Messrs. Luney Bros. of Victoria have the general contract for the building, the cost of which will be about $75,000. They expect to have the building completed ready for occupancy by December 1st. The architect is C. E. Watkins, Green Block, Victoria, B. C.

The interior fittings and finish of the building are to be of the highest grade, and a great deal of mahogany and plate glass will be used in the finish of the ground floor, and in connection with the record rooms, of which several will be provided. Two elevators will be installed, one being hydraulically operated for handling freight, and the other being a passenger elevator in the store itself. Heating will be by steam, which, however, will not be generated on the premises, but obtained from the heating plant in the Spencer building next door.

The Loxel Tile Co. of Ontario, Ltd., has been incorporated with a capital of $60,000. The temporary address is 518 Clinton Street, Toronto.

Messrs. McDougall & McNeill, Ltd., of Vancouver and Calgary, have secured the contract for the construction of the first unit of a large plant for the Wigwam Pulp & paper Co., near Elko, B. C. This includes the construction of a power dam on the Elko river, which will store water enough to provide 25,000 horse-power.

Record for Erection of Structural Steel Made in Chicago

Every so often we hear of a new record in the erection of structural steel frames being established, but one has recently come to light which promises to stand as a real record for sometime to come. 7,500 tons of steel erected in 70 working days is a feat that any erection company can be justly proud of. With two stiff-legged derricks and a crew of 90 men working an eight hour shift for 5½ days per week, the Overland Construction Company, Chicago, erected the steel frame for the Illinois Merchants Bank Building.

The building is to be 21 stories high and is 316 feet by 178 feet, but is being built in two sections. One half is to be finished and occupied before the other section is started. The total amount of steel used in the two sections will approximate 15,000 tons.

The steel was erected in two storey lifts, the derricks working independently of each other and lifting themselves up to the next level when the two stories had been erected. The time of placing two stories was approximately 4½ days and the record day was when 320 tons of steel were placed. Each derrick had a 112 ft. mast, 100 ft. boom and was operated by a 100 h.p. electric motor.

7,500 tons of steel erected in 70 working days

Poole Construction Company, Limited, head office Regina, Saskatchewan, have established a permanent office at Edmonton, Alberta.

How Should Water be Sterilized?

A Report on the Water Supply of London, Eng., Contains an Explanation of the Methods of Using Chlorine in its Various Forms for Water Sterilization

Sir Alexander Houston in his sixteenth annual report on the water supply of London, Eng., draws attention to the importance of the method in which the sterilising agent is applied in water treatment. There are various possibilities, but far too little attention has hitherto been given to the important matter of rising the water and to the equally important point of perfect mixing.

Methods of Administering Chlorine to Water

The writer receives so many queries as to the best methods of administering chlorine to water, that the following brief notes may prove to be of value.

Gaseous.—The chlorine gas is liquified under pressure, and is contained in steel cylinders possessing specially contrived exit valves, and the gas being in the anhydrous state does not act on the metal. The problem is to bring the chemical into final relation with the water to be treated in such a way as to secure uniformity of dose. As the pressure of the gas varies with the temperature, it is necessary to reduce it to a constant which is independent of all normal atmosphere variations of temperature (say, from 80 to 25 lb. on the sq. in.). This reduction of pressure is produced by the use of a patent reducing valve or valves, and without going into any description of their merits, or the principles controlling their action, it may be said that in effect they satisfactorily achieve their object. The gas thus leaves the cylinders through copper tubes under a high but varying pressure, and emerges from the reducing valves under a constant pressure, but in volume, and therefore in sterilizing power, susceptible of control by what practically amounts to a tap, or a gas valve, capable of being controlled at will. Obviously, however, there must be some method of measuring how far a turn of the controlling gas valve corresponds with an increase or decrease of the volume of gas delivered from the apparatus. This is effected in two chief ways, either by allowing the gas to displace sulphuric acid or some other suitable liquid in a syphon U tube, the number of "pulses" being correlated with the volume and therefore the weight of gas escaping, or by allowing the gas to pass through an orifice of fixed size, the difference of pressure on the two sides of the orifice being measured by means of a manometer. As this difference of pressure varies according to the rate at which the gas passes, a scale may be constructed either by calculation (knowing the size of the orifice and the physical constants of the gas) or by direct experiment, whereby the rate at which the gas is passing may be read off. It then only remains to know the rate of flow of the water to be treated and the control valve is adjusted to give the requisite dose of chlorine.

Next comes the delivery of the gas to the water to be treated, either as a gas, or after its preliminary solution in water.

As regards the former, ingenious devices exist for passing through porous plates, bulbs or cylinders of some carborundum-like material immersed in the water, the gas escaping into the water in the form of infinitely small bubbles, or possibly as a sort of "chlorine sweat."

Application of Dissolved Gas is Preferred

The writer has had some experience in the past of this method, and although it worked admirably when the water to be treated was not too cold, it failed immediately under less favorable climatic conditions, owing to the formation of a solid hydrate of chlorine which choked the pores of the diffusers. Since then, the writer understands that great improvements have been effected, but the much safer method of dissolving the chlorine gas in water by appropriate means and delivering it as a solution is to be preferred. For example, the gas may be allowed to escape into a glazed earthenware tower containing pieces of the same material and water allowed to trickle through it continuously, thus dissolving the gas and producing a perfect solution of chlorine, which is allowed to flow out of the tower through a hard rubber pipe into the water to be treated. The volume of water used is immaterial provided solution is complete, but the error should be largely on the side of excess, as in this way more perfect final mixing is obtained. In the anhydrous state chlorine does not act on metals, it is only after contact with water that its intense corrosive action is manifested. In the presence of water the use of materials such as glass, earthenware, porcelain, hard rubber, &c., are essential. It is most desirable that the mixture of the solution of chlorine and the water to be treated should be as rapid and as perfect as is reasonably practicable. In the case of an open aqueduct a perforated pipe across the aqueduct, some 2 ft. or 3 ft. below the surface, seems to be fairly effective, but some form of baffle or sluice immediately below the point of application very materially assists in obtaining complete mixing. Far too little attention is paid to this highly important point of perfect mixing, as the success of the treatment may hang on this very circumstance. The Paterson Engineering Company Limited, and the United Water Softeners, Limited, supply apparatus for chlorinating water successfully by means of liquid chlorine, and the writer has had ample opportunities of testing practically the value of their instruments. The apparatus (Wallace and Tiernan patents) used by the latter firm can also be used for dechlorinating water by means of liquified sulphurous acid gas.

Liquid Chlorine

Various solutions of chlorine prepared electrolytically may be used, but the writer has had most experience with the alkaline hypochlorite solution containing about 12 to 14 per cent of available chlorine, prepared by the United Alkali Company, and sold under the trade name of "Chloros." The writer used this substance most successfully as far back as 1905 at Lincoln, in connection with the typhoid epidemic there. In emergencies there is a great and obvious convenience in having a sterilizing agent in a liquid form. If it could be produced and delivered at waterworks at a price in terms of available chlorine more nearly corresponding to bleaching powder, or liquid chlorine, its sphere of usefulness would be greatly extended. Chlorine of lime and liquid chlorine are close competitors in the matter of price. Chlorine of lime containing about 33 per cent. of available chlorine costs £16 6s. 8d. a ton, or 5¼d. per lb. of available chlorine. Liquid chlorine is, of course, of 100 per cent. strength, and it costs about 4d. per lb. If Chloros contained 14 per cent. of available chlorine, its price per 0.1 gallon (= 1 lb.) would, assuming approximately equal costs as regards carriage, &c., have to come down seemingly to about 3/4d. to compete commercially with, say, chloride of lime.

Chlorine in Solid Forms

Cloride of lime (bleaching powder) contains about 33 per cent of available chlorine, and is added to water as a solution. Previous to its use at Staines in May, 1916, a large number of experiments were carried out in the laboratory to discover the best way of mixing it with water, the depth of sludge produced, the volume of water required for the primary and secondary mixing operations, and other details connected with the production of a bleach solution of a convenient strength. These preliminary procedures were very important, as chloride of lime does not mix at all readily with water, and unless the operation is carried out on scientific lines, the solution obtained is not clear and there is loss of available chlorine and therefore waste of money. The investigations of the staff of the Water Examination Department were so successful that the type of plant chosen for use in 1916 is practically the same as the writer recommends for employment in 1922. It has the great advantage that all the parts can be bought in the open market at a moment's notice, and the constructional work is of a simple nature.

The essential features of the apparatus may be described and illustrated as follows:—

The apparatus consists of two mixing tanks of about 150 gallons capacity, two or more storage tanks of 1,000 gallons capacity, and two balancing tanks capable of holding about 20 gallons. These tanks can be of galvanized iron, but must be painted with some resistant paint, such as bitumastic, to prevent corrosion; indeed, all parts of the apparatus coming into contact with the bleach solution should be similarly treated.

The tanks, &c., must, of course, be arranged at such levels as to allow the liquids contained in them to flow by gravity to the point of treatment.

The outlet of the mixing tanks consists of a 2-in. elbow looking upwards inside the tank connected through the wall of the tank to a 2-in. pipe. The top of the elbow should be at such a height from the bottom of the tank as to allow some 60 gallons to remain in the tank when run off; further, a guage mark should be fixed near the top of the tank, so that exactly 75 gallons are contained between the gauge mark and the level of the outlet.

The outlets of the two mixing tanks are connected and the common outlet continued, so as to deliver into any one of the storage tanks. The outlets of the storage tanks consist of 2-in. elbows looking down, so that the bottom of the elbow is about 2 in. from the bottom of the tanks. Each outlet is fitted with a valve and is connected with a common pipe conveying the solution to one or other of the two balancing tanks, which are fitted with ball-valves to maintain a constant head on the control valve.

All the valves are full-way gate-valves, and the pipes up to the balancing tanks are 2-in. diameter, the delivery pipe from the latter if short is ½ in. diameter and the central valve a ½ in. full-way gate-valve.

The above arrangements are the direct outcome of experiments carried out on a small scale in the laboratory in the early part of 1916 to discover what was the best way of mixing chloride of lime with water, so as to produce a clear bleach solution without loss of more than traces of available chlorine.

Both the mixing tanks have sludge outlets delivering into the sludge pit. The supernatant liquid from the settled sludge can be drawn off by means of an "adjustable outlet arm" into another smaller tank, whence it may be pumped up to the mixing tanks and used again for mixing. This allows of the last traces of available chlorine being utilized for sterilization purposes, and also assists in the final disposal of the sludge.

Mixing Process

The process of mixing is as follows: One-eighth part of the total amount of cloride of lime is weighed out in pails and put into one of the mixing tanks, which has previously been partially filled with water, or with the sludge liquor from a previous mixing. The tank is then filled to the gauge mark with water, and the contents well stirred and pounded (this is very important), and then allowed to settle for about half to three-quarters of an hour. Meanwhile, the second mixing tank is similarly charged. When the sludge has settled in the first tank, the liquid is run off into one of the storage tanks, a second charge of chloride of lime is added and the tank filled with water to the mark and again allowed to settle. When each tank has been charged and run off four times, they are filled up, settled and run off twice with water only, the object being to wash as much as possible of the available chlorine from the sludge.

It will thus be seen that 12 charges of 75 gallons each, making 900 gallons in all, have been run into storage tank, and the liquid, after being thoroughly stirred is analyzed chemically ta ascertain the amount of available chlorine actually present, and knowing the rate of flow of the water being treated, it is easy to calculate the rate at which the solution is to be run into the water for any particular dose. The rate of addition to the solution is measured by determining the number of seconds reqcired to fill a quart measure, and as the number of seconds in one hour is the same as the number of quarts in 900 gallons, the rate of addition of the solution in seconds per quart is also the number of hours the tank will last. The storage tanks are usually mixed with sufficient chloride of lime to last separately for one day, and the amount in lb. can be arrived at by multiplying the dose (parts of av. cl. per million parts of water) by 30 (assuming the chloride of lime to contain 33 per cent of av. cl.), and the product by the number of million gallons of water to be treated per twenty-four hours. It is advisable (if not absolutely necessary) to determine by analysis the actual amount of chlorine present, and adjust the rate of addition of the solution accordingly.

This can be arrived at by the formula $R = \frac{216S}{F D}$

Where R=rate of flow of solution in secs. per quart.
S=per cent available chlorine in solution.
F=rate of flow of water treated in m.g. per day.

D=dose in parts available chlorine per million.

When the mixing is complete, the sludge remaining in the mixing tanks is run into the sludge pit and the tank made ready for the next day's mixing.

It is found that a certain amount of fine sludge collects in the storage tanks, but it is only necessary to run this off into the sludge pit occasionally (say, once a month).

The plant described is capable of treating 25 to 50 million gallons per day, with a dose of 0.3 (or less) to 0.8 parts of chlorine per million, and, of course, by working the storage tanks more rapidly, say, two per day, still larger amounts can be treated. For smaller amounts smaller tanks may be used, or the 1,000 gallon tanks made to last two days, but it is found in practice to be difficult to maintain a steady flow with a less rate than, say, 1 quart per minute, owing to the smallness of the aperture in the nearly closed control valve. With such low rates a soft lead nozzle fixed to the control valve, which can be easily expanded or contracted to give approximately the correct rate, is found to be a great advantage, the control valve being used as a fine adjustment.

It has been proved that if the storage tanks are covered the solution will maintain its strength for a much longer period than if left uncovered.

The mixing of chloride of lime with water so as to produce a clear bleach solution, without appreciable loss of available chlorine, is not a pleasant task, and the plant doubtless presents an unsightly appearance, but if all the operations are carried out in the exact manner here described the method is almost "fool-proof," and is extremely cheap, almost exactly 33 per cent of chlorine (i.e., practically all that is available) being extracted from the material. This is a striking example of the way laboratory experiments on a small scale may sometimes enable a large plant to be designed and installed without previous practical trials on a big scale, and yet fulfil all essential requirements, a result which otherwise could only have been reached by perhaps one or more preliminary failures.

Aeration of Sewage for Small Towns

Careful Consideration of All the Factors Involved is Essential Before a Municipality Should Commit Itself to Sewage Aeration by Means of Drop Manholes

Toronto, Sept. 18, 1922.

Editor, Contract Record:—

With reference to the article by Mr. W. G. Cameron under the above heading which appeared in your issue of September 13, the suggested method of purification of sewage which he makes is one which requires very careful consideration.

The breaking up and consequent aeration of sewage in a sewer system has never been favored by the highest sanitary authorities, and drop manholes were discountenanced by the engineers of the Local Government Board of England many years ago. Difficulty is invariably found in providing for the disposal of the foul air that results from the breaking up of the sewage, and unless the ventilating stacks are of exceptional height, complaints of the smell, whether real or imaginary, are constant, especially as the moist air is visible in cold weather. It is always a problem to find a suitable design and location for the ventilating stacks on public property, and the varying use to which adjoining property may be put often leads to the demand for their removal after installation, and new locations are doubly hard to secure.

From observation of the working of deep drop manholes constructed from my own designs, simply to overcome excessive grades, I am prepared to endorse the statement of Mr. W. H. Horner of the St. Louis Sewer Department, "that the tumbling basin introduces unknown factors into a sewer system which we now think best to avoid if possible."

In a combined sewer system of any size, especially where the grades are great, the surge in the flow of sewage is often surprising and the effect in a deep drop manhole is to constantly change the pressure of air within the sewer. In the sewer system of Vancouver, B. C., all sewer connections are open vented, no disconnecting traps being used except those on plumbing fixtures, but in spite of this free ventilation the varying pressure in sewers with deep drop manholes can be discerned in the traps of the plumbing fixtures adjacent to the same.

Two of the large main sewers of the Vancouver and Districts Joint Sewerage Board discharge into deep wells and I gather from press reports that some trouble has been experienced at the wells by the sudden release of entrapped air. It would be of value to engineers engaged on sewer design if the engineers in charge of these sewers would state how the trouble arises and what steps have been taken to overcome the same.

If a sewer system has an outfall on a high cliff, such as the Niagara Gorge, some advantage might be taken of the fall to break up and aerate the sewage, but I do not think that many experienced sewer engineers would advocate the breaking up of sewage within the sewer system itself.

As the sewage systems of small towns are often designed by engineers who have not had long experience in sewer maintenance and observation of sewage flow, it might be an unfortunate experiment for any small town to attempt the purification of sewage in the manner suggested by Mr. Cameron without the most careful consideration of all the factors involved.

Yours very truly,
A. G. Dalzell.

Housing Activity in Toronto

The Toronto Housing Commission was recently granted a permit for the erection of 19 brick dwellings, to be erected on Bain and Logan Avenues, at a cost of $100,000. The houses will be erected in four blocks, two and a half storeys high.

Survey of Sewage Treatment Plants

Results of an Investigation Aiming to Secure Data on which Efficiency Could be Judged and to Suggest a Standard Test to Make Results at Different Plants Comparable*

During the summer of 1920 the U. S. Public Health Service undertook a survey of fifteen sewage treatment plants located in twelve cities in different parts of the country which were considered to exemplify different typical processes and conditions. The objects of this survey were: 1—to obtain a bird's view of the field of sewage treatment; 2—to secure basic data by which the efficiency of service could be judged; 3—to suggest some standard test which might, without undue labor, be adopted to all plants so that results at different plants would be comparable.

The plants selected for the survey were, therefore, those which were felt to be representative, receiving reasonable, careful and intelligent operation. The devices and processes employed at these plants included primary plain sedimentation, septic, hydrolytic and Imhoff tanks; fine screens; trickling contact and intermittent filters; secondary sedimentation; and activated sludge. It was originally planned to study chemical precipitation and Dortmund tanks, but they were for various reasons omitted from the schedule. At no plant visited was routine disinfection practised.

The basic data were collected by an engineer and a chemist. The engineer learned the details of design and construction of the plant, the population and industrial plants contributing to the sewers, and other factors bearing upon the operation of the plant together with the operating details; in some instances making special investigations of the use of sludge as a fertilizer or other subjects. The chemist spent from ten days to over two weeks at each plant analyzing an average of 12 series of 24-hour composite samples, taken hourly before and after each phase of the treatment. The samples were stored on ice during the period of collection and determinations were made by the same chemist (except at four plants), thus assuring identical methods and eliminating the personal equation in the comparison of results from any two plants. No nitrogen determinations other than nitrates were made at any except the activated sludge plant, where the ammoniacal nitrogen determination is of value in judging the efficiency of the aeration.

Types of Plants Inspected

The plants surveyed were as follows: Imhoff tanks and trickling filters without secondary sedimentation at Atlanta, Georgia and Columbus, Ohio; plain sedimentation and Imhoff tanks with contact beds and final intermittent filters of fine cinder or sand at Alliance, Ohio; Imhoff tanks and contact beds at Canton, Ohio; hydrolytic tanks, fine screens, trickling filters, secondary sedimentation and sludge digestion tanks at Baltimore, Maryland; Imhoff tanks trickling filters and secondary sedimentation at Rochester, New York, Fitchburg, Massachusetts and Lexington, Ky.; septic tanks, trickling filters and secondary sedimentation at Reading, Pennsylvannia; Reinsch-Wurl screens, followed by Imhoff tanks and disposal by dilution without oxidation at Rochester, New York; activated sludge plants at Houston, San Marcos and Sherman, Texas. At Alliance and Canton, Ohio, were glass-covered sludge drying beds.

The average amount of sewage treated was about 94 gallons per capita, nine cities having smaller flows and six larger, six of the total being within 10 per cent. of the average, five others within 25 per cent. and the remaining four differing from the average by 36 per cent. to 38 per cent. The number of people served per sewer connection averaged 5.4 per cent.

The character of the sewage at the plants varied widely. Suspended matter ranged from 101 to 297 parts per million, averaging 174. Sewages with less than 100 parts per million are seldom encountered nor are there many municipal sewages carrying more than 297 parts except at plants where an unusual amount of industrial waste reaches the sewers.

Suspended matter was determined both in Imhoff glasses and by the Gooch crucible. The former gave settleable solids ranging from 1.9 to 4.9 c.c., which did not correspond very closely with the suspended matter as determined by the crucible. The Imhoff glasses gave readings of 4.8 c.c. with sewage containing 261 parts per million of suspended matter, while only 2.7 c.c. with sewage containing 297 parts and 2.0 c.c. with sewage containing 101 parts and others containing as high as 226 parts. The Gooch crucible method was considered much more reliable than the Imhoff glass.

The oxygen consumed values by the 30 minutes in boiling water method, ranged from 24 to 69 parts per million, averaging 44.

The five-day biochemical oxygen demand averaged 114 parts per million, with a range betweet 67 and 190.

Imhoff Tanks

The Imhoff tanks removed on the average 50% of the suspended matter, and below 60 at only two plants; the figures at these plants, 37% and 40%, pulling down the average considerably.

The biochemical oxygen demand was reduced 42.5% and the permanganate oxygen consumed 36%. It is interesting to note that the reduction of the five-day oxygen demand was greater than that of the oxygen consumed. Studies by the U. S. Public Health Service at Cincinnati have indicated that removal of solids affects oxygen consumed to a much greater degree than it does oxygen demand.

Considering the amount of suspended matter in the effluent, which is more important than percentage removal, the Imhoff tank effluents at half the plants contained between 60 and 70 parts per million, while the highest of the fifteen plants was 119 and the lowest 40. Detention periods for normal flows averaged about 4 hours calculated on total displacement basis, and the velocity 0.6 foot per minute on the same basis.

With but one or two exceptions, most of the tanks foamed at one time or another, but this was more of an occasional nuisance than a serious difficulty and relief could be obtained by withdrawing the sludge, which method was accepted by all the plant operators as the only one giving permanent relief.

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*From an article in Public Health Reports, by H.H. Wagenhals, Associate Sanitary Engineer of the U.S. Public Health Service.

The capacity of the digesting chambers below the slot averaged for 10 of the 12 installations 1.1 cubic feet per capita served, the other two having capacities of 2¼ to 2½ cubic feet.

Trickling Filters

At six plants the trickling filters were preceded by Imhoff tanks, at one by hydrolytic tanks with a few Imhoff tanks, and at one by a septic tank. The depth of filters ranged from 5 feet to 10 feet but was between 5 and 6 feet in six of the eight plants. The rate of filtration of four plants was below 2,000,000 gallons per day and the other four above. The appearance of the effluent was good except from one plant where there was considerable pooling. Some of these filters had been in continuous operation 10 to 12 years with very little expense other than occasionally going over the surface with a pick or harrow or flushing with a hose.

Although the raw sewages had a wide range of concentration, the effluents of the trickling filters were all so similar in composition that they might have come from the same filter on different days. As the filter is an oxidizing device, its efficiency must be judged not by the amount of suspended matter but by determinations involving the presence of oxygen. Those made were oxygen consumed, oxygen demand and nitrogen as nitrates. The last is considered of little value unless the amount of nitrogen in other forms present in the influent is known. Omitting the clogged filter, the oxygen consumed values fell within the range of 7 and 19, and the five-day oxygen demand between 4 and 20. The one clogged filter had an oxygen consumed value more than twice the average of the others and an oxygen demand value about 2½ times as great as the maximum for the others. The reduction of the methyl orange alkalinity was at no plant under 30% and at one plant was 92%, reducing from 99 to 8 parts per million. This same reduction in alkalinity was found in all properly operated oxidizing devices, such as the contact beds and aeration plants of the activated sludge process.

Contact Beds

While the results of the contact beds at Alliance and Canton were not equal to the average of the trickling filters, they were entirely satisfactory for ultimate disposal with the dilution factors available. The oxygen consumed values were 11 and 18 respectively and the oxygen demand values 20 and 37. At neither place are these filters operated during the winter months.

Fine Screens

"The analytical method used in the survey failed to show any accomplishment by the screens at Rochester during the period of the survey. Suspended and settleable solids and oxygen consumed were slightly higher in the effluent than the influent and the oxygen demand was slightly lower, but in none of the determinations was the difference of any significance. Computing from the screenings collected back to equivalent solids, the removal amounted to less than 1% or 2%." A rotating drum screen in Baltimore removed solids likely to clog the sprinkling filter nozzles and their efficiency is best represented by a reduction of about 87% in nozzles cleaned after the installation of the screens.

Activated Sludge

The activated sludge plants studied were two at Houston, one at San Marcos and one at Sherman, all in Texas. The two latter are quite small, the San Marcos plant treating less than 200,000 gallons a day The latter plant was visited every day by a general utility man who oiled the machinery and made a brief general inspection. The influent was a weak domestic sewage which had been previously passed through a septic tank. After this double treatment the effluent contained about three parts per million of suspended matter, and oxygen consumed value was about 8 and the oxygen demand about 16, with ample contained oxygen in the form of dissolved oxygen and nitrates to more than satisfy the demand. The annual cost of operation was about $1,400, or $20 per million gallons or $.56 per capita served, the contributing population being about 2,500.

Discussing the practicability of activated sludge plants for smaller communities, Mr. Wagenhals believes that too much emphasis has been placed on the so-called automatic operation of other types of sewage treatment devices and that none of them will work satisfactorily without attention and suggests that there is a distinct inherent advantage in a process that necessitates some attention. Motors and air compressors cannot run day after day without at least being oiled and to insure a daily visit to the plant is an important advantage. He even suggests that the activated sludge process may find its greatest field of usefulness in small installations rather than large ones, the sludge problem being greatly reduced in small installations where the amount is not sufficient to make possible the recovery of commercial value.

The plant at Sherman treated sewage that was extremely concentrated and fresh, receiving large amounts of night soil, and the effluent was poor. The installation of a preliminary settling tank might greatly facilitate operation of the aeration plant. The two Houston plants produced excellent effluents and the problem there was the ultimate disposal of the sludge. (Recent tests with sulphur dioxide seem to promise fairly satisfactory solution of this problem).

Utilization of Sludge

At Alliance, Canton and Rochester the sludge is all used by local farmers, charge being made at Rochester. The benefit of sludge to grasses, wheats, oats and other crops is very evident at Canton. Unfortunately, none of the results obtained by the farmers can be given in quantitative figures. One farmer stated that by actual weight he obtained with two cuttings, 34 tons of grass from 9 acres treated with sludge, while 40 acres in the same field not so treated totaled only 42 tons. It is admitted that such reports are different from experiences of other places. The author believes that at most sewage treatment plants a local demand for sludge can be created on an actual value basis which will even produce a revenue that will help pay for handling the sludge after its removal from the tanks.

Causes of Failure

Sewage treatment plants may fail in operation either because (1) the processes may not in themselves be capable of producing a good effluent; (2) the design of the individual plant may be at fault; (3) it may be poorly operated, or as is often the case, receive no operation at all.

Although opinions have been expressed, even among those familiarly connected with sewage treatment, that the whole system and theory of sewage treatment practices have fallen down, this survey made by the Public Health Service indicates that "there does not appear to be much ground for pessimistic criticisms of general theories of sewage treatment on the basis of their failure to effect adequate purification."

The second cause of failure can be largely eliminated when public and especially city officials thoroughly understand that the designing of treatment plants is a specialized branch of professional engineering and that such plants are not a part of the city's plumbing system.

Laboratory Determinations

The primary function of preparing sewage for disposal by dilution without creating objectionable conditions either at the plant or in the receiving body of water was being accomplished by the plants visited with one or two exceptions. At only two out of the 14 operating oxidizing devices was the color reduced in the methylene blue putrescibility tests of the effluent incubated at room temperature, and at one of these two the samples stood up for from 3 to 8 days. Only four of them had biochemical oxygen demand in excess of 20 and all contained oxygen to partially satisfy this demand. Moreover, the treatment process removed practically all of the settleable solids.

These two results, the reduction of solids and the partial oxidation of the organic matter not removed by such reduction, are the two functions commonly required of such plants. In isolated cases the reduction of bacteria may be desirable for the protection of near water supplies or bathing beaches. This being the case, Mr. Wagenhals believes that two determinations, one for the removal of suspended matter and the other for the reduction in oxygen demand, are the backbone of the laboratory routine of the average plant. With special methods of treatment others may be needed, as for instance the ammoniacal nitrogen determination for controlling the aeration processes at activated sludge plants. Of course, when bacterial removal is a function of the plant, total bacteria counts are essential for the proper operation of the disinfecting process.

What is Effect of Alkali on Concrete?

A Study of the Chemistry of Portland Cement and Its Disintegration by Alkaline Ground Waters—Various Theories Explaining the Action that Takes Place

By Prof. T. THORVALDSON
Professor of Chemistry, University of Saskatchewan

At the general professional meeting of the E.I.C., Winnipeg, Man.

The problem of the so-called action of alkali on concrete is generally considered to be peculiar to the prairie provinces of Canada and the corresponding states south of the international boundary. There is no doubt that those regions of the prairies, having a low rainfall and poor drainage, present extraordinary conditions in respect to the amount of soluble salts present in the soil. The experiences of engineers in the dry belt of western Canada and the western states have indeed brought this problem very forcibly to the attention of scientists and the general public.

Analysis of the ground waters on the prairies indicate that high concentration of dissolved salts is fairly general both in the surface stratum and at lower depths. Shallow wells, and excavations for foundations of buildings, very commonly give seepage water having a concentration of one-half of one per cent. up to even six per cent. or more. In Saskatchewan, at least, water from deep wells, where a large supply of water under pressure is struck in the lower strata, has commonly total solids of one-half of one per cent.

Analysis of Water from the Prairie Provinces

The dissolved salts are, in general, mainly sodium, magnesium and calcium sulphates. Occasionally there is a large quantity of common salt present as well. Typical analysis of three waters taken near cement structures in the three prairie provinces follow:—

	Man.	Sask.	Alta.
	Parts per Million		
Total solids	20,022	16,010	18 492
Sulphate	14,180	11,090	12,153
Chloride	440	331	trace
Carbonate	413	225	429
Calcium	524	433	432
Magnesium	2,560	1,771	607
Sodium (by difference)	1,948	1,863	4,505

Expressed in hypothetical combinations, as weight of each substance, in grams, per 100 cc.

	Man.	Sask.	Alta.
Sodium sulphate	0.52	0.51	1.39
Magnesium sulphate	1.27	0.88	0.31
Calcium Sulphate	0.08	0.09	0.03
Calcium carbonate	0.07	0.04	0.07
Sodiumchloride	0.07	0.05	trace
Total solids	2.01	1.57	1.80

In the above samples of Manitoba and Saskatchewan waters magnesium sulphate predominates, while in the Alberta water sodium sulphate is present in larger quantity. Waters of the latter type are also quite common in Saskatchewan. The differences in actual concentrations of these three waters are not significant as the seasonal variations of concentration are large.

Reasons Advanced for Failures in Concrete

Until lately all failures of concrete were attributed to defective concrete, the defects being supposed to have existed either in the cement or aggregate, or in the method of manufacture of the concrete. Perhaps the only exception to this was when some engineers considered that failures of concrete structures exposed to sea water were due to the salts in the sea. The best known of these failures was that of the dock at Aberdeen, Scotland, built in 1875, of which a description is given in the Proceedings of the Institution of Civil Engineers, in 1891. Other cases occurred at Hartlepool, Sunderland, Scarborough and Belfast where docks failed to stand up. Engineers, however.

did not reach a unanimous opinion as to the causes of these failures. Some thought that the failures were due to a cement too high in lime, and that the magnesium chloride in the sea water combined with this. Others thought that the cause lay in too high a percentage of magnesia in the cement. In 1871 Dr. Michaelis, of Berlin, published a paper on "The Behavior of Portland Cement in Sea Water," in which he stated that, "The salts contained in sea water, especially the sulphates, are the most dangerous enemies of hydraulic cements." In the case of the failures at Scarborough, investigation was made by B. D. Butler and the conclusion arrived at, that the damage was due to land water containing sulphates. He says: "Waters containing calcium or other sulphates are a serious source of danger to cement concrete exposed to their action, and they are liable to attack the cement and to cause deterioration, with, in extreme cases, disintegration of the mass."

While the evidence as to the cause of failures of concrete structures in sea water is very conflicting and in Great Britain, at least, the general opinion seems to be that well made structures of dense concrete will stand up indefinitely where they are constantly immersed in the sea, yet there is no longer any doubt that well made concrete, manufactured from the best of materials, will not stand up long if in contact with such ground waters as the three of which analysis is given above. In the case of dense concrete in contact with such solutions, the outer layer softens slowly and all cohesion between the cement and aggregate disappears. This action proceeds gradually inwards. Often the outside has a blistered appearance which is due to breaks in a thin shell of calcium carbonate formed on the outside, while the damage proceeds beneath. If the concrete is porous, action will take place throughout the mass instead of proceeding gradually from the outside. In walls or floors made of such concrete where evaporation can take place, as for instance, inside of a basement, incrustations, composed mainly of sodium sulphate, form. The salt solution penetrating the wall from the outside evaporates leaving the salts on the inside of the wall. This occurs also commonly on concrete structures just above the water line, at the surface of a damp soil rich in sulphates, or at the level to which the soil solution rises by capillary action. Thus while the water penetrating the concrete may not have a high concentration of sulphates, increase in concentration takes place through evaporation until the solution is saturated. On further evaporation incrustations of salts form on the concrete structure. This explains why "alkali" action usually appears first, in foundations of buildings, at the surface of the soil, or at the upper limit to which the soil waters commonly rise. The concentration of the salts in the water further down in the soil may be fairly low so that the action appears there later, or even may not appear at all if the concentration is too low.

Constitution of Cement

The question then presents itself as to the nature of the action of these salts on the concrete. Before one can inquire into this matter it is necessary to have a clear idea as to the nature of concrete. The part of the concrete which is acted upon is the cement, and thus we have to study the constitution of cement before we can draw conclusions as to the action of salts on it. Before proceeding further it is therefore necessary to summarize briefly the work on this subject to date, especially the results of the work of P. H. Bates, A. J. Phillips and A. A. Klein of the United States Bureau of Standards, and of E. S. Shepherd, G. A. Rankin and others of the Geophysical Laboratory of Washington.

Perhaps the first definitely planned research on cement was carried out by John Smeaton in 1756 when he determined to attempt to find "the most perfect cement possible" for the building of the Eddystone lighthouse. He found that for mortar, to be used in water, the purest lime was not the best, but that the lime giving the best results was really chalk impregnated with clay. Pure lime would not harden under water while burnt clayey lime did harden. Thus he obtained a hydraulic lime mortar, which when mixed with pozzolana—a pumice-like material of volcanic origin—produced a satisfactory mortar for the lighthouse. While this may be considered the beginning of the cement industry, the material was not constitutionally, except in a slight degree, like portland cement of to-day. The name "portland cement" appeared first in 1824, when Joseph Aspdin, a bricklayer of Leeds, took out a patent for making a cement from limestone and clay; the name being taken because the set product resembled the stone quarried at Portland, England. This cement was burned at a low temperature without the formation of clinker which is formed by partial fusion. The hard product when formed by "overburning" was generally rejected, although it was more like the portland cement of to-day. Later the value of the hard-burned product was recognized and the production of portland cement, as we know it to-day, began shortly after the middle of the 19th century.

The pioneer work on the constitution of cement was done by a number of men of whom one might mention Bergman of Sweden, Saussure of Switzerland, and Vicat of France. The last named, who may perhaps be considered the founder of cement chemistry, explained the hardening of hydraulic lime by chemical action of the lime on the alumina and silica, while ordinary mortar made of rich lime and sand required carbon dioxide for hardening, and if excluded from carbon dioxide remained soft for a number of years. On the other hand rich lime mixed with finely ground pozzolana hardens in a short time in water, the lime and the pozzolana combining chemically.

In 1887 Le Chatelier published a paper which is now a classic on the constitution of cement. The microscope and chemical analysis supplemented each other in his research. He concluded that portland cement contains tricalcium silicate, tricalcium aluminate, "calcium ferrate," and "multiple silicates."

The work at the Geophysical laboratory and the Bureau of Standards, Washington, indicates that the chief constituents of well burnt clinker of portland cement are tricalcium silicate, dicalcium silicate, tricalcium aluminate, and clay or glass high in oxide of iron, with 5.3 calcium aluminate and calcium oxide as minor constituents. These conclusions have now been generally accepted.

Let us try to follow what happens during the burning of portland cement, and instead of taking the usual materials let us begin with the pure oxides of calcium, aluminum and silicon in the proper proportion for portland cement, (say $CaO=68.4$; $Al_2O_3=8.0\%$; $SiO_2=23.6\%$). While raising the temperature to 1,000°C we can consider that nothing happens, unless the lime was present in the beginning as calcium carbonate, in which case the carbon dioxide of the limestone would be evolved. Above 1,000°C the lime begins to combine with the silica to form dicalcium silicate. The calcium oxide also combines with the alumina to form the 5.3 calcium aluminate, while there still remains a large excess of free lime. As one continues to raise the temperature some of this free lime combines with the aluminate to form tricalcium aluminate. At 1,335°C flux, or molten liquid, first appears as this is the eutectic temperature for the system composed of the above three compounds, namely, dicalcium silicate, tricalcium aluminate, and 5.3 calcium aluminate. As the system is heated above this temperature a new reaction begins, the free lime combining with the dicalcium silicate to form tricalcium silicate. The 5.3 calcium aluminate also combines completely with the free lime to form tricalcium aluminate. At about 1,475°C the calcium aluminates have disappeared entirely into the liquid phase, while free lime, dicalcium silicate, and tricalcium silicate, remain in the crystalline condition; the last growing in amount rapidly at the expense of the two former. If kept above this temperature, but below 1,650°C the reaction will run to completion, the lime disappearing entirely and on cooling the charge crystallizes completely, giving a clinker approximately of the composition 45 per cent. tricalcium silicate, 35 per cent. dicalcium silicate and 20 per cent. tricalcium aluminate.. If instead of stopping at about 1,650°C the charge were heated above 1,900°C, the tricalcium silicate would dissociate into dicalcium silicate and free lime. If other substances, such as compounds of iron are present, as in the commercial burning of portland cement, the flux appears at a lower temperature and complete burning will therefore take place at about 1,425°C with a corresponding change in the proportion of the main products present.

Properties of Main Components

We will summarize briefly the properties of these main components of normal portland cement, as described by the experimenters above.

Tricalcium Silicate:—This compound is formed from dicalcium silicate and lime with alumina only above 1,335°C and is decomposed again when the temperature reaches 1,900°C. When mixed with water it has properties very similar to portland cement, except that it is slightly less plastic. The plasticity is increased to that of portland cement by the addition of 3 per cent. plaster. The initial set is quicker than that of normal portland cement. Briquettes made of this gain most of their strength within seven days and almost all in twenty-eight days. Tests on hydration show that most of this also takes place in the first seven days and almost all within twenty-eight days, giving a mass of very dense structure of gelatinous silicate interspersed with crystals of lime hydrate. Thus lime hydrate is formed during the hydration by the decomposition of the tricalcium silicate. Some of the most valuable properties of portland cement are conferred on it by the tricalcium silicate which it contains, namely, those of setting within a reasonable interval, developing strength rapidly, and forming a non-porous dense mass.

Dicalcium Silicate:—This is a very stable compound as is seen from the fact that it is not decomposed at its melting point, which is about 2,130°C. When kneaded with water it has no plasticity and gives no true set. When in contact with water for two to three weeks it hydrates and hardens slowly, small amounts of lime being formed. It is thus much more stable than the tricalcium silicate in respect to water. In three to four months it has gained as great strength as the quicker setting tricalcium silicate. It has then a sandy structure containing voids or cavities in which water may freeze or salts crystallize, with attendant strain due to the physical forces of freezing or crystallization.

Tricalcium Aluminate:—This substance hydrates almost instantaneously with great evolution of heat, and gives a "flash set" which is due to its agglomeration into masses with the hydrated material on the outside, preventing further hydration of the inside of the mass. On further addition of water the mass becomes plastic and does not again set or harden. A large amount of water is required for complete hydration, and the mass remains plastic for a long time.

It may seem peculiar, considering the apparent inferiority of the dicalcium silicate and the tricalcium aluminate to pure tricalcium silicate, that the last named is not used instead of portland cement. Without going into details one can state that the reason is mainly one of cost, the pure tricalcium silicate not being obtainable at commercially practicable temperatures. Furthermore, tricalcium silicate is found as a primary phase only within the ternary system and alumina is the most convenient substance to use for this purpose. Then there are probably indirect advantages on account of the presence of tricalcium aluminate. Through its property of rapid hydration it assists in breaking up the particles of finely ground clinker. Its presence seems to speed up to a slight extent the hydration of the silicates. Furthermore, in the presence of free lime the aluminate is not so active with water and acquires some cementing qualities. The substances containing the iron and magnesia are not active and probably play no part in the hydration of the cement.

Process of Hydration

One may summarize the process of hydration of portland cement thus: The tricalcium aluminate hydrates first and the physical disintegration taking place assists in the hydration of the silicates which follows. At first amorphous hydrated tricalcium aluminate is formed but this later crystallizes. Any small amount of free lime present hydrates and reacts with the aluminate, producing cementing effect. The next substance to react is the tricalcium silicate and the hydration of this is well advanced in seven days. After this comes the crystallization of the hydrated aluminate and the hydration of the dicalcium silicate. Thus early strength, (within twenty-four hours). is probably due to hydration of the aluminates and lime, the increase in strength up to seven days due mainly to the hydration of the tricalcium silicate, and the later increase in strength due mainly to the hydration of the dicalcium silicate.

Action of Alkali Ground Waters

How can we apply these facts to the better understanding of what happens when alkali ground waters act on set portland cement. Experiments on the preparation of concrete using water containing a high concentration of alkali salts indicate that the early development of strength through hydration is not interfered with. Cement briquettes will develop nearly full strength when cured in sulphate solutions of a concentration which later causes disintegration. Thus the alkali disintegration seems to be so slow in its action that the effect on the fairly rapid process of hydration is not noticeable. It is, therefore, likely that the action of the alkali is on the products of hydration of the chemical compounds in cement clinker.

Work done at the Bureau of Standards, Washington,[1] the Montana Agricultural College, and at the Universities of Wyoming and Saskatchewan, has brought out certain facts as to the chemical changes which take place when concrete disintegrates in solutions of sulphates.

(1) The simpler silicates, in general, when treated with water hydrolyze, the water becoming alkaline and the solid becoming richer in silica.

(2) During the hydration of the calcium silicates present in portland cement, hydrated lime is formed with hydrated silicates of higher silica content.

(3) If the hydration takes place in pure water, in a system of limited capacity, equilibrium is soon attained and this prevents further extraction of the hydrated lime from the concrete.

(4) When water in contact with the concrete contains temporary hardness or carbonates, the hydrated lime reacts with this, forming a shell rich in calcium carbonate on the surface of the concrete.

(5) When water in contact with concrete contains sodium sulphate in solution the sulphate is removed from the water, and the water develops caustic alkalinity.

(6) When water in contact with concrete contains magnesium salts as well as sulphates in solution, both the magnesium and the sulphate are removed from the water while the water remains nearly neutral.

(7) The hydrogen ion concentration of solutions of sodium sulphate in contact with hydrated cement does not vary with change in concentration of the sodium sulphate while the total alkalinity varies considerably.

(8) The hydrogen ion concentration of solutions of magnesium sulphate, or mixtures of sodium and magnesium sulphates in contact with hydrated cement, varies with the concentration of the magnesium sulphate present and, in general, in the same direction as the total alkalinity.

The Chemical Action That Takes Place

From these it is possible to decide in part what chemical reactions take place during the action of sulphate solutions on cement and concrete. The free lime produced during the hydration of the calcium silicates in the cement has a slight solubility in water. On account of the low solubility and the consequent tendency to attain equilibrium in a thin film of liquid on the surface, the extraction of hydrated lime from cement by pure water is slow. However, fair-sized crystals of hydrated lime may form on the surface of briquettes stored in distilled water. This leaching out of hydrated lime progresses most rapidly in the case of cements high in tricalcium silicate, while cements in which dicalcium silicate largely predominates are not so active. This statement holds in practice only for specimens of equal permeability to water, and since dicalcium silicate, after setting, is much more porous than tricalcium silicate this advantage of the lower silicate disappears in practice. If bicarbonates or carbonates are present in the water these react with the hydrated lime forming insoluble calcium carbonate which may form a protection against further removal of lime and a partial protection against the action of sulphates from the outside. However, this protection is usually quite inefficient, at best, delaying the sulphate action somewhat.

When sulphates are present in the water, in contact with the concrete, the conditions are entirely change.d The calcium of the hydrated lime reacts with the sulphate radical and calcium sulphate is formed. The solubility product for this substance is low, and the presence of a large concentration of the sulphate ion will therefore render it almost insoluble. It separates out of solution as the hydrated form of gypsum. The removal of the calcium from solution in this manner upsets the equilibrium between the dissolved and solid hydrated lime and speeds up the leaching out of this substance from the cement, while the moment it enters solution the calcium continues to be precipitated as gypsum. If the sulphate present is sodium sulphate, the liquid attains thus caustic alkalinity, while the sulphate disappears as gypsum into the solid phase. On the other hand, if magnesium salts are present as well as the sulphate, the hydroxyl ion is removed neutral, while both the magnesium and the sulphate radicals disappear from the solution and enter the solid phase. Thus the presence of dissolved magnesium salts and sulphates in water which is in contact with cement or concrete, produces ideal conditions for the constant removal of lime from the lime silicates in the cement, with the consequent weakening of the concrete and when carried to completion final loss of all cementing properties.

The theory that the disintegration is due to the physical forces exerted during the crystallization of gypsum in the voids in the concrete can hardly stand as a sole explanation. The amount of free lime in properly manufactured set cement is small and the combination of this amount with sulphate could not explain the observed effect. Continued extraction of lime is necessary and suitable conditions for this process are produced by the presence of sodium and magnesium sulphates. This alone is enough to cause the weakening of the concrete and loss of the cementing qualities of the silicates. The crystallizing of the gypsum no doubt contributes to the final results by causing fissures in the weakened concrete and thus facilitating the access of the harmful sulphate waters to the interior portions of the concrete.

One must not draw the conclusion that the above statement explains everything about the disintegration of concrete by sulphate waters. There probably are other contributing factors. There can be little doubt that the process described above can by itself cause complete disintegration of lime silica cements. But there may be contributing factors which, if excluded, would cause a slowing up of the action to such an extent as to lose its seriousness. At present the only remedy known is the manufacture of concrete of low permeability and high strength, and this is only an expedient for lengthening the life of the structure. The only certain remedy is the exclusion of sulphate waters of high concentration from contact with the concrete and tried, cheap, efficient means for this are not available. Substitution of the calcium aluminates possessing cementing qualities in place of the calcium silicates has led to the development of the so-called "electric cement" and "ciment fondu", but further work is necessary before one can determine the resistance of these to the action of sulphate waters.

The Contract Record's

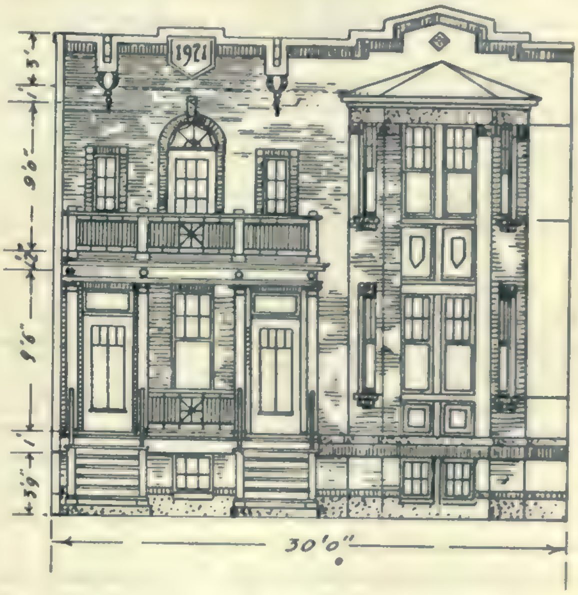
Weekly House Suggestion No. 37

The house shown on the accompanying drawings has lately been built in one of the residential districts of Montreal and was designed by Mr. Alcide Chausse, a prominent architect of that city.

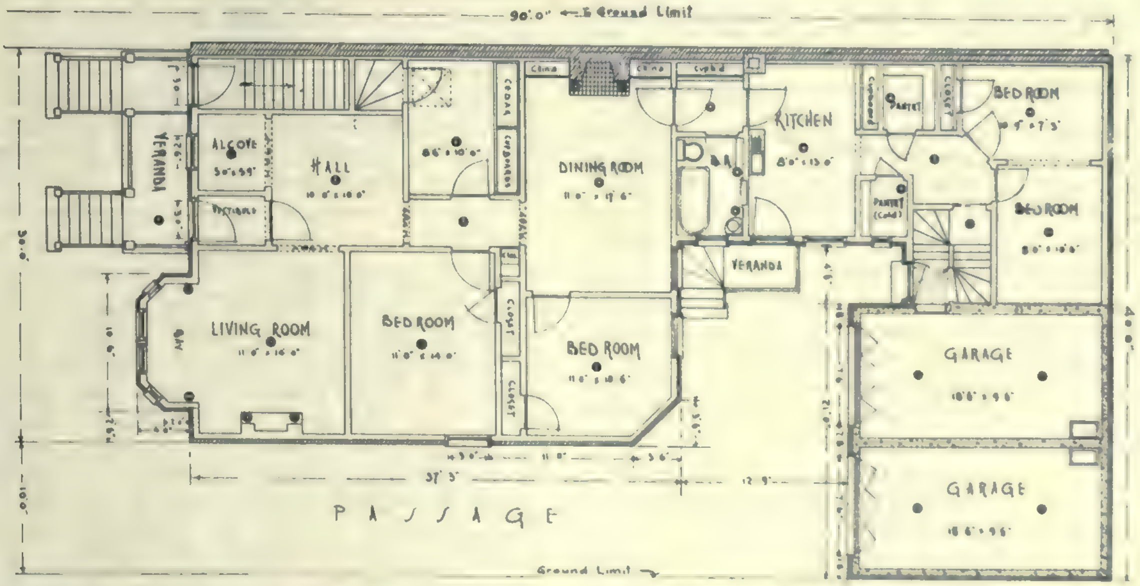
This house contains two superimposed residences. It is compact but at the same time airy and well lighted, as will be readily seen from the accompanying illustrations. The necessary ground for a house of the size shown here is 90 ft. x 40 ft., including an allowance for a 10-ft. passage. The house measures 30 ft. in frontage by 37 ft. in depth, with a 33 ft. extension. The foundations are of concrete and the walls of solid brick. The ground floor contains spacious living and dining rooms, measuring 11 x 14 ft. and 11 x 17 ft. 5 in. respectively. There is in the dining room a large brick fireplace with tile base, on each side of which are china cabinets. There is a fireplace in the living room, which also contains an extra large bay window. Ample room is provided for large wardrobes in the bedrooms. There is adjoining the hall a large storage or trunk room to which are connected large cedar cupboards for fur storage. The kitchen part of the house is exceptionally well equipped. It is well lighted and contains a warm and a cold pantry.

The floor of the upper residence is divided similarly to the lower floor, with the exceptions of the addition of a den 10 x 6 ft. 3 in., situated above the entrance to the lower residence.

The interior walls are finished with cornices and all flooring is of hardwood. There are front and back verandahs for both residences. The cellar contains storerooms and two independent coal bins and furnaces, besides a large finished space for the use of the tenants.



The cost of this double house was $20,000, which price includes a double garage, of fireproof construction, each stall measuring 18 ft. 5 in. x 9 ft. 5 in.



Mainly Constructional

East and West—From Coast to Coast

The city council at Halifax recently authorized the expenditure of $50,000 for a war memorial.

The city council at Fort William, Ont., recently authorized the expenditure of $40,000 on the development of Chippewa Park.

Saskatoon building permits so far this year total $1,566,899, more than treble the amount for the same period last year.

Damage estimated at $1,000 was caused by a fire recently at the plant of W. E. Dillon & Co., sheet metal works, Jarvis St., Toronto.

On October 1 the ratepayers at Edmonton, Alta., will vote on a by-law authorizing the expenditure of $325,000 for the erection of a municipally controlled power plant.

A fire at the plant of the Grimsby Brick & Terra Cotta Company, Grimsby, Ont., resulted in damage estimated at $20,000. It is reported that the company will probably rebuild.

Forty members of the American Association of Port Authorities, which met in annual convention at Toronto recently, visited Montreal after the convention for the purpose of inspecting the harbor and port facilities.

By an almost unanimous vote, the tax payers of Calgary ratified the agreement of the city with the Imperial Oil Limited for the establishment of a $2,500,000 oil refinery here. The only concession asked by the company was that their assessment be fixed at $250,000 for 20 years. A start on actual construction is expected shortly.

A six-year combined course in art and architecture will shortly be instituted by the Department of Architecture of the University of Toronto, according to an announcement made at the annual convention of the Ontario Association held in Hamilton recently. The new curriculum will be introduced as soon as the Board of Governors ratifies the plan.

A complete examination of the water works plant at Kingston, Ont., to determine the cause of impurity of the water, was made recently, but not a single defect was apparent in the entire system. It is thought, therefore, that the source of supply in the lake must be contaminated and if so, the pipe will have to be extended to a purer source.

The total area of pavements laid at Hamilton so far this year is 110,000 square yards, as compared with a total of 100,000 square yards of asphalt laid during 1921. The works program is not completed as yet, and it is anticipated that paving operations will be carried on until the end of the year, if an open winter is experienced.

An agreement has been reached between the contractors and carpenters at Brantford, Ont., which calls for a 44-hour week, with a minimum wage for journeymen carpenters of 70 cents an hour, union carpenters only to be employed, unless the union is not in a position to supply the demand for men within 24 hours after application.

Tenders will be received on October 4 for the construction of a new Arts Building, in connection with the huge development scheme of the Western University of London, which will cost approximately $500,000. Contracts recently were let for a Science Building of similar value, and a new $250,000 bridge to the University grounds is well under way.

Carpenters, plasterers, tinsmiths and sheet metal workers are in great demand in Winnipeg at the present time, according to J. Neish, superintendent of the trades and casual branch of the local bureau of the Employment Service of Canada, but the officials are experiencing difficulty in finding men to fill the positions.

The large new plant of the Canadian Firestone Tire & Rubber Company at Hamilton is getting under way and it is expected that within a few weeks time a full staff of 500 men will be employed. Another favorable development in the industrial situation in Hamilton was the re-opening recently of the molding plants of the International Harvester Company.

A convention of representatives and officials of the townships and municipalities of Waterloo County, Ont., was held at Preston recently to discuss the road problems of the county and a number of resolutions were formulated and forwarded to the Highway Department. Following the meeting the delegates were tendered a banquet at Bernhardt's Hall, being the guests of the Preston Town Council.

Mr. P. J. Veniot, minister of public works of New Brunswick, announced recently that at a conference with P. L. Squires, chairman of the executive of the Canadian Good Roads Association, arrangements were made for a meeting of representatives of provinces interested in road work under the Federal aid scheme. It will be held in Montreal at a date to be arranged later.

The Department of Roads, Quebec, has announced that the Levis-St. Lambert Highway, the second national highway between Quebec and Montreal, will be completed next fall. The total length of this highway will be 180 miles, 90 miles of which is practically completed now. The road will cost, it is estimated, $1,500,000, which is just about half the cost of the Quebec-Montreal highway.

This year's house building program at Ioco, B. C., where a townsite is being created around the Imperial Oil Company's refinery, will be completed with the erection of four bungalows, the contract for which was awarded to the Dominion Construction Company recently. This will bring the number of dwellings erected this year up to 19. This development started about a year and a half ago and with this year's program the total number of homes will be 72, carefully laid out in a model townsite plan. The scheme is financed by the company, who in turn sell the houses to the employees on very easy terms.

Personal

Mr. E. L. Cousins, general manager and chief engineer of the Toronto Harbor Board, was elected third vice-president of the American Association of Port Authorities at their recent convention in Toronto.

Obituary

Mr. John Reid Duncan, manager of the Vulcan Iron Works, of British Columbia, died recently as a result of injuries sustained in an aeroplane accident. Deceased was on his way to keep an appointment with Hon. J. D. King, Minister of Public Works, at Sumas Lake, when the pilot, Major Claire McLaurin, in attempting to make a landing, lost control of the machine which fell killing him and fatally injuring Mr. Duncan. A. L. Hartridge, a mechanic, who was also in the machine when it fell, escaped with painful injuries to his back and leg. Mr. Duncan was 42 years of age and had received his training in the iron and steel business in Scotland. He had been manager of the Vulcan Iron Works for the past 13 years and was in full charge of the huge Sumas reclamation scheme which is being carried out in British Columbia.

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director

HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U.S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, October, 4, 1922 No. 40

Transportation Changes

The three reports which have been recently received by the province of British Columbia on the problem of the Pacific Great Eastern Railway incidentally serve to emphasize the revolutionary changes which are in progress in the conception and practice of the business of transportation on this continent. The difficulties of this railroad, while primarily due to disregard of fundamental economic principles when the broad lines of the scheme were drawn, have been accentuated by the fact that the line parallels, for practically its entire best productive section, the old Cariboo Trail, now a well kept highway and the traditional freighting route for everything going in to "the upper country." In spite of the great differences between the rates charged by the motor freighters operating on the road as compared with the rail rates, a considerable proportion of the passenger and fast light freight continues to travel over the road, owing to the rapid and convenient service possible where light units such as motor cars are in use.

One of the authorities consulted by the government advocates the adoption of light motor units for the rail service, in which recommendation the report follows the trend of railroad practice elsewhere, forced to this action by similar competition. Another of the authorities, dealing with the question of the competing highway, makes the suggestion that this trunk road should be put upon a toll basis for through traffic which competes with the railroad, and that the proceeds of toll should be devoted to the improvement of the system of feeding market roads, and presumably to the upkeep of the trunk road itself.

The system of the tolls on main roads was in use at a time before the railroads had taken freight transportation off the roads to the then new arteries, and it is regarded by some as entirely logical, with freight trending back to the roads, that a partial return to the toll system should be open for consideration. This would be a means of establishing a fairer basis for competition than now exists as between the unorganized freighters and the railways, and would be far preferable to any attempt to fight the independent motor freighter out of business altogether.

The latter tactics are being pursued at the present time by a group of short roads in the south-eastern states, which have banded together in an attempt to secure legislation which will eliminate this sort of competition. The attempt can hardly be successful. Change, based on mechanical improvements such as this is, cannot be blocked permanently by the old order, and a far preferable line of attack is the one which is aimed at the discovery of methods of regulation which will put the railroads as well as the highways in a position to handle the traffic in harmony with economic requirements.

These two suggestions, both made by engineers of many years experience in transportation work, seem to contain the germ of a probable satisfactory solution of the new problem.

Fire Prevention Campaign

By royal proclamation, His Excellency, the Governor General of Canada has designated October 9th as Fire Prevention Day. During this present week, lessons on fire prevention subjects will be given in every public school, public meetings will be held in many of the large cities, towns and villages, and the owners and occupants of property everywhere throughout Canada will be counselled to give special attention to the removal of fire hazards from their premises.

Fire waste is one of the most serious economic problems confronting Canada at the present time. The public in general is vitally affected by the tremendous losses annually incurred by fire and the enormous expenditures rendered necessary to adequately protect life and property from its ravages. Seeing that at least eighty-five per cent of all fires are caused by carelessness and can therefore be prevented, it is the obvious duty of municipal authorities, fire department officials, boards of trade and other representative citizen bodies to bring the matter to the attention of the people.

Some of the facts relative to Canada's fire loss are best emphasized in the Governor General's proclamation, which is given herewith as best indicating what is desired in connection with the fire prevention campaign.

Whereas, it is authoritatively stated that during the past decade in Canada more than 3,000 persons have lost their lives and insurable property having a value in excess of $250,000,000 has been destroyed by fire;

And whereas the loss from this cause, which in the year 1921 reached the unparalleled total of $45,-

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Canada's Engineers—Angus Smith, C.E.

The name of Angus Smith, C.E., is widely known among municipal engineers of Canada, and, although a graduate of the School of Practical Science, Toronto, 1894, Mr. Smith has recently graduated from civil or city engineering into the commissioner or city manager class, being Public Utilities Commissioner of Calgary, Alta. This is a comparatively new field for civil engineers, whose training eminently fits them for the duties of city commissioner or city manager.

Commissioner Angus Smith has had a wide and varied experience as a city engineer, and has paid special attention to pavement construction, as attested by the very excellent pavements in Regina, Sask., and Victoria, B. C. The Ross Bay and Dallas Marine drive foreshore protection sea walls in Victoria, B. C., are monuments to Mr. Smith's thoroughness and reliability in engineering practice.

Mr. Smith has been given the degree of Civil Engineer from Toronto University, is also a member of the Engineering Institute of Canada, and a member of the Professional Engineers of Alberta.

000,000, is rapidly increasing despite the praiseworthy efforts of numerous agencies made for its abatement;

And whereas in addition to this recorded waste of human life and created resources, forest fires annually destroy merchantable timber worth many millions of dollars and immature forest growth of inestimable potential value thus adversely affecting one of Canada's most important branches of industry, depleting our natural heritage of forest wealth and impoverishing, if not entirely destroying, the future productiveness of large forest areas;

And whereas the waste thus occasioned, represented in terms of human life, money, labor, time and natural resources, cannot be re-created but is an absolute and irrevocable loss largely distributed over the entire population through the agency of fire insurance which imposes an inescapable and burdensome tax upon industry and thrift and substantially adds to the cost of living;

And whereas it is shown by reliable statistics that at least ninety per cent. of the fires which occur originate either directly or indirectly through inexcusable ignorance and neglect and are therefore preventable and that the exercise of reasonable prudence and proper carefulness on the part of responsible individuals would reduce losses by fire in Canada to the comparatively insignificant proportions of losses in other countries;

And whereas economic and humanitarian considerations imperatively demand that human life and material resources in Canada be so far as possible conserved in order that the national prosperity may be maintained amidst world wide competitive conditions and that the general welfare of the people may be measureably increased;

And whereas it is desirable that the attention of the public be directed to the extent and underlying causes of the preventable loss of life and property by fire and to the best and most practicable means for its control and that a specific period of the year be set apart and properly designated for the dissemination of such information;

Now know ye that we, by and with the advice of Our Privy Council of Canada, have thought fit to appoint and do appoint Monday, the ninth day of October, in this present year, as "Fire Prevention Day," and we do recommend to all Our loving subjects that on that day or at some time during the week immediately preceding as may be found most practicable,—

1. All dwellings and their surroundings be carefully inspected by their occupants and all conditions likely to cause or promote the spread of fires removed.

2. All public buildings, stores, warehouses and factories be inspected and cleaned of rubbish in order to reduce fire hazards and maintain health and safety.

3. All hotels, theatres, asylums, hospitals and other institutional buildings be inspected and pro-

vision made for all changes necessary to protect the occupants from danger in the event of fire.

4. Fire drills be held for the children in all schools, for the inmates of all institutions and for the employees in all large stores and factories in order that a greater degree of safety may be ensured by acquainting the occupants with the best and most expeditious mode of exit in time of danger.

5. Special instructions on the subject of fire prevention be given by the teachers and by municipal officials in the schools and that such appropriate literature as may be made available be distributed to the pupils.

6. Boy Scout leaders give instructions to the troops under their control as to the best means of co-operating with municipal fire departments in the prevention and extinguishment of fires and especially as to the desirability of qualifying for the fireman's badge.

7. Operators of lumber camps, settlers, campers, hunters and others who may from time to time enter our national parks and forest areas acquaint themselves with all laws, regulations and precautionary rules devised and established for the safeguarding of the woods against fire.

8. All legislation and regulations enacted or issued by Dominion, provincial or municipal authorities dealing with fire prevention be given publicity by the municipal officials and that by public meetings or otherwise as may to them seem most fit, they endeavour to impress upon the citizens the national importance of safeguarding life and property from loss by fire.

Gypsum Withstands Fire

Experiment at Chatham, Ont., Demonstrates the Effectiveness of Gypsum as a Fire Resisting Material

The effectiveness of gypsum materials as fire retarding agents was remarkably demonstrated by a fire test carried out recently in Tecumseh Park, Chatham, Ont., the experiment being arranged for the benefit of the fire chiefs of the Dominion who were assembled in convention at Chatham. The first demonstration was carried out in a building erected by the Ontario Gypsum Company, with gypsum board on wood studding. It was filled with dry hay, wood, oil and other combustible materials and set on fire. The heat was naturally terrific but the fire was allowed to follow its own course and after it died away, a stream of water from a fire hose was turned upon it. Outside of being blackened and stained by smoke, the house was uninjured and examination showed that the studding and frame work beneath the gypsum board were uncharred and in as good condition as when first erected.

Another demonstration showed the effective work done by sprinkler systems. Both interior and exterior of a wooden building were equipped with apparatus of this character, which came into play almost immediately upon the commencement of a fire within the building.

The fire chief of Chatham, in commenting on the splendid manner in which gypsum withstood the test, stated "An examination of the wood joisting and studding in the tested areas, after removing sections of the gypsum and plaster protective covering, showed them to be in an undamaged condition. Fires were placed on the roof, against the outside and in the interior of the building, burning for a considerable time and being allowed to go out of their own accord. The damage done was practically nil, there being but one small crack in the building."

Montreal Harbor Works

Operations are Under Way for the Enlargement of Piers and Docks and the Improvement of Shipping Facilities

Plans for extensive harbor improvements in Montreal approved by the Minister of Marine and Fisheries were put into operation recently when dredges commenced work at the end of Alexandra pier, preparing the way for an extension of 300 feet to the present 1,000 foot construction. The addition will be built by the Atlas Construction Co., Limited, whose tender of $295,250 was recently accepted by the Harbor Commissioners. According to the terms of the contract the crib-work sub-structure will be completed by October 31 next, the lower half of the superstructure by December 15, and the whole of the work not later than May 31, 1923.

Within the next few days work will be commenced by the same firm on a similar extension to King Edward pier, which is to be completed by June 15, 1923, and for which the company will receive the sum of $314,700.

This fall will also see the beginning of the immense new grain elevator to be constructed at Tarte pier, which is to be built in sections and added to as the requirements of the port dictate. The chief engineer of the port stated that plans have been completed for construction of the first unit, and that this is expected to be in operation by the fall of 1923. Each unit will be self-contained. When completed, the Tarte pier elevator will be one of the largest in the world, with a storage capacity of from eight to ten million bushels. The capacity of the first unit constructed will be two million bushels.

The addition of 300 feet to the length of Jacques Cartier pier, work on which has been going on throughout the present summer, has now been completed, and the construction of double-storey sheds similar to those on the old part of the pier will be commenced. Very satisfactory progress is being made with the work of deepening the channel approach to Bickerdike pier, for which the sum of $97,849 was allocated in the proposals submitted to the Hon. E. Lapointe by the Harbor Commissioners.

The commissioners' new extension jetty at elevator No. 2, especially constructed for the speedy loading of tramp grain steamers, was put into operation for the first time some days ago, when grain was supplied to the steamer Grainton. The jetty will be able to supply grain to two vessels simultaneously at the rate of 80,000 bushels an hour, or 40,000 bushels an hour each. The system is convertible and will permit three or all of the belts to be used to load one steamer, when necessary.

How Building Design is Influenced by Mechanical Equipment

The Necessity of Providing for Such Facilities as Water, Gas, Electricity and Steam Conductors, Ventilation, Refrigeration, Elevators, etc., Has an Important Bearing on the Structural Layout

How the structural design of such large buildings as offices, hotels and apartments is influenced by considerations of the various mechanical appliances and equipment required for such buildings was the subject of a recent paper read before the Western Society of Engineers by H. L. Clute, chief engineer of the Arcade Steam Heating Co., Chicago. An abstract of this is given below, as indicating how adequate provision must be made for the installation of service plant:

Mechanical equipment of a building is that part which furnishes such utilities as water, gas, electricity, steam, conveyance, ventilation and refrigeration. In preparing the preliminary and structural design of the building it is necessary to have a general conception of the equipment to be provided, or when too late it may be found difficult to make suitable provision and arrangement.

Three classes of equipment are practically common to all buildings: plumbing, electric wiring and steam. Plumbing includes drainage, water supply, gas and often vacuum cleaning.. Wiring is for light, power, telephones, signal system, clock system, telautograph and special purposes. Six semi-common classes are elevators, ventilation, electric generation, refrigeration, pneumatic tubes and sprinkler system. Special installations are required to serve hotel kitchens and laundries, theater stages and similar cases. Each installation may be divided into three classes: Apparatus, conductors and accessories.

Equipment is Often Complex

To illustrate the complexity of the equipment, the water installation may include the following: Two mains for cold water (at city pressure and high pressure); two hot water mains each with supply and circulation return systems; a main and return for drinking water; brine supply and return mains, and high and low level drainage and storm water mains. Steam distribution may include high, medium and low pressure service, each with supply, return and drip mains. In a typical example there may be thirty systems of horizontal pipe mains each with five to ten risers or vertical lines through the building, and each riser with four to forty branches. These mains are at different levels, with risers extending either upward or downward. Interspersed with these pipes will be from five to twenty duct lines, with branches, pneumatic tubes and electric feeders.

Structural provisions for such equipment include ample floor area for machinery and apparatus, continuous horizontal and vertical spaces for mains and risers, space for offset for branches, and faciliites for convenient operation and maintenance. In the ideal condition all the mains would have the shortest possible leads from producing apparatus to utilizing apparatus, but paralleling the main axes of the building. But in the actual condition the equipment is twisted and distorted to keep it out of the way and out of sight. This arrangement of the equipment to meet actual conditions with efficiency and economy is sometimes one of the principal problems of the mechanical engineer.

Pipe Mains and Basement Girders

Piping is grouped usually at basement ceilings more than at any other place, and here trouble is caused by deep beams and girders. In general the profile of the main must be a straight line with only a slight inclination from the horizontal. For this reason the entire main must be below the bottom of the deepest girder, except when some special provision is made. One building has most of the girders 26 in. deep and some 32 in. deep. As the mains must be below the latter, this brings them far below the ceiling and makes an unsightly arrangement.

This problem is one for the structural engineer. Of course the economical section of a girder is a deep one. To provide the necessary strength by increasing the width of girder instead of the depth in order to maintain a uniform depth would involve extra expense. But in certain cases this construction expense would be warranted by the saving in expense for mechanical installations and by the greater convenience and reliability in the operation of the mechanical plant. Pipes are sometimes laid through holes in the centre of steel girders, but with reinforced concrete there would be the liability of interference with the reinforcing bars, especially where the girders are of varying depths.

Pipes and Floor Framing

In the upper part of the building, pipe mains are laid usually above suspended ceilings, but here also the depth of beams and girders is a factor.. In some cases a certain depth of furring has been assumed below the ceiling panel and is found to be insufficient for the piping.. Then some method of increasing the depth must be found. Sometimes the pipes are carried down and around in cornices and false beams across the panels. This may be necessary but is objectionable in requiring an excessive number of turns or bends in the piping. Where a floor filling of not less than 5 in. depth is available certain mains may be laid in this fill.

A double floor at some point in the height of the building is very desirable, especially in hotel buildings where there are a certain number of special floors in the lower portion and typical or uniform floors above. I believe that in time every hotel building will be designed with a double floor construction above the special floor and below the typical floors, because all of the pipes and risers coming down the upper part of the interior of the building must be disposed of. They must be offset individually and carried down columns and in partitions and special places with various crooks and turns, or they must be collected together at mains in a floor space below the typical floors. To permit free access this space should be at least 3 ft. high.

One of these floors is the main load-bearing floor and the other is an auxiliary floor of short spans, either suspended from the main or carried above it on struts. The tendency is to place the auxiliary floor below the main floor, with the idea that all the deep beams and girders and trusses may be carried in this space and leave a flat ceiling below, whereas, if the main floor were below and the auxiliary floor above those deep beams and girders would be exposed on the ceiling. This is a mistake. As stated in connection with basement mains, those beams and girders will not permit the passage of pipes, so the depth of the pipe space should be the required amount below these beams, except that under the beams it may be reduced and workmen may crawl under beams and find a working space in the panels. In general it is best to place the working floor below and the auxiliary floor above, as the space between the girders will then be available to add to the height of ceilings in the rooms below.

Pipes and Cable Shafts

A pipe shaft of ample size for riser trunks should be provided.. A width of 3½ ft. is generally sufficient if the length is great enough to accommodate all the pipes in one layer. This is usually placed alongside of the smokestack, and a good arrangement is to use a beam or girder at the side of the smokestack for a walkway in the shaft, building the shaft of sufficient additional width to place the pipes.

Electric cables and feeders are carried up through the building at the centres of approximately equal areas, so that the distances from the cable shafts to the sides of these areas will be not over about 80 ft. If the area of the building is divided into as many units roughly of that size as required, and a cable shaft provided in each one it is a very adequate provision. It is seldom the case that the cable shaft is carried up continuously from the basement or lowest floor through the building, but it should be built in this way.

Steam risers are usually near the outside walls and plumbing risers at the interior of the building. The former may be furred in with the columns or carried up in chases. With skeleton construction it is usually difficult to provide chases, but some structural engineers are using construction in which the spandrel beam is 4 in. thinner than the thickness of the wall, the inside face of the beam being set back 4 in. from the inside face of the wall. This permits of carrying up a chase through the skeleton framing and gives an excellent opportunity to conceal the steam risers. Many buildings of the better class are now having these pipes concealed.

Interior risers are placed usually in shafts large enough to give working space for a man in maintenance and repair work. A width of 28 in. is about the minimum for a plumbing shaft. Sometimes these shafts are made continuous, or without the floor fill at each floor, and are then used as the exhaust shafts for the toilet rooms. If the floor is open, steel doors are required for access. That is fireproof construction. If they are closed at each floor ordinary wood panels may be provided. If they are left open the entire area has to be framed, whereas with the closed shaft the pipes may be carried up in sleeves between the reinforcing rods. It is always a question as to which type is best.

If the pipes or risers are furnished in special non-accessible shafts they are either at the columns or in such special locations as may be found here and there. If they are at the columns there is always the question of space required; in addition to the amount required by the pipes there is always a beam carried out from the centre of the column, leaving the only available space at one side of this beam. It would be an advantage if there could be some way of designing twin beams where there are a number of shafts of this kind, especially in office buildings. That is, beams side by side, so that the extra space inclosed with the columns would be entirely utilized for pipes. This plan would add very little to the size of the column. Where the pipes are placed in various shafts wherever it may be convenient, no structural provisions are necessary.

Elevators

With electric elevators the machines are located usually over the shafts. Beam framing at the floors carries the guides and must be designed for vertical loads imposed by the emergency brakes gripping the guides. Pits require a depth of 3½ to 4 ft. for spring buffers or 6 to 8 ft. for oil buffers and 9 ft. for compensating cables. In fact elevator manufacturers are always asking for deeper pits. This involves drainage systems, as the pits are rarely watertight.

Boiler-Room Space

Space provided for the boilers is found frequently to be inadequate for proper boiler capacity. Two boilers are preferable to one of equal capacity in order to provide for cleaning and reserve. Three boilers are preferable to two for plants of over 15,000 sq. ft. of radiation. Headroom is often insufficient owing to a desire to limit the depth of excavation, but there should be ample space over the boiler to give free access for inspection of safety valves, automatic checks, main valve and other accessories. For cast-iron, return tubular and water-tube boilers the minimum headroom may be taken as 9, 15 and 28 ft. respectively, although some water-tube boilers require 32 ft. and some may be as low as 22 ft. Thus the type and size of boiler are factors in the building design.

Space must be provided for access to all sides of the boiler and for a firing floor in front. This latter may be from 5 to 10 ft., the latter being sufficient for withdrawing a mechanical stoker.. For protection of the floor above the boiler room, an insulated ceiling is preferable to air circulation in the space over the boilers. Where coal is fed by gravity from a bunker to the mechanical stokers the minimum height from boiler-room floor to bottom of bunker will be about 12 ft. Allowing a 40 deg. slope for the bunker bottom, this gravity feed system will require a basement or sub-basement height of about 30 ft. When this is not practicable, the main bunker may be on the boiler room floor with a conveyor carrying the coal to an auxiliary bunker which feeds the stokers.

Smokestack

The area provided for this will depend upon the boiler capacity together with the thickness of insulation and the 4 in. clearance space required by the city ordinance. Since its height varies with expansion and contraction it must be supported at one point, either on a special foundation or on a girder framing in the superstructure. The latter case requires the special attention of the structural engineer.

Engines

Where engines and generators are installed a height of 15 ft. will usually be sufficient to provide space for the large amount of piping that must be placed along the ceiling. Engine foundations must not be in contact with column foundations or floors, a joint filled with elastic packing being used in the floor.

House Tanks

Every building of the class noted requires house tanks sufficient for 20 to 60-minute supply in emergencies. One hotel has two 10,000-gal. gravity tanks in the roof pent house for domestic supply. Other buildings have two 4,000-gal. tanks. With two tanks one can be cleaned while the other is in use. To provide support of such tanks may involve special structural design.

Air Conditioners

These are often required in connection with the supply system of ventilating equipment and should be placed as nearly as possible in the direct line of travel from the intake to the ventilated room. The apparatus includes a fan, motor, air-washer and heaters, requiring usually a length of 26 ft. For upper floors, the conditioners may be placed in an interior room which is made available by leading to it an intake duct over the ceiling. A good location in a large building is behind the elevators, the rear wall of the elevator shaft being set back far enough to accommodate the conditioner units, with direct intake through the wall to the unit.

Is Plastering Up to a High Standard?

There is Frequently Inferior Workmanship that May be Minimized by Competent Inspection—Hand Made Mortar is Disappearing—Poor Sand Responsible for Bad Plaster

By E. J. CURRY
Plastering Contractor, Toronto

In the "Contract Record" of May 10, page 412, there was an article entitled, " Is Plaster Always Properly Sanded?" In my opinion, this is a very difficult question to answer, more especially if the plastering contractors are allowed to make up their own material on the job, such as hair or brick mortar that is used for interior or exterior plastering. The larger contractors of this city very seldom use the old hand-made mortar preferring the prepared material from supply houses which comes properly mixed and requires only the addition of water to prepare it for use.

Day of Hand-Made Mortar is Gone

Personally, I claim that the day of hand-made mortar is gone. I would not trust any mortar man to make me up any material for interior plastering on wood or brick, because to my mind, they let the lime burn before it is run off into their box. They put the hair in while the lime is hot which burns it and it is a question of putting lots of sand in to make a large bed and when they are through thep have not got mortar but only sand and dead lime mixed together, which is no good at all. The manufacturers who make the prepared materials for all classes of work give you the right proportions, and the larger contractors have no trouble whatsoever with their work as far as the material goes, as every bag that is shipped from the factory carries the usual guarantee. There are many who will not agree with me regarding the manufactured product, but in my opinion, there is no comparison whatever and I can highly recommend prepared materials every time.

The article referred to stated that a certain plastering contractor digs out an inferior grade of sand from some of the lots and uses it for plastering. To my knowledge, that is not anything new as contractors have been doing this for twenty-five years in the city of Toronto, mostly in speculative house work. The bricklayer comes along, digs out the sand for the excavation in the cellar and he uses what he wants for the brickwork on the house. The plasterer comes along and he uses it also. It is always loam sand, to which is added a little hair, the product being called mortar. This kind of material is right in vogue today to as great an extent as ever. I do not know how we can stop it and as a result buyers of such houses are the sufferers every time.. They find inside of a year that the plaster not only cracks but the ceilings fall down and it cannot be otherwise because really the mixture is just sand and burnt lime added together and is not as strong as common mud. Therefore, the public suffers every time from this class of so-called plastering contractors.

An Inspector for Plastering Work

I quite agree with your article in regard to some of the other trades. There is an inspector who looks over all the men's work and unless it is 100% effiicient, he will not pass it. Consequently, this mechanic will try to do his work right so as to assure his employer that he is a first class workman. There should be an inspector for such an important trade as plastering as in my opinion it is the best craft in the building trades, but one which is little thought of. If you were to take out of most of the prominent buildings in the province of Ontario the ornamental and decorative plaster work, they would be a sight for some museum, but half of the public imagine the plasterer is only a fellow who slaps mud (or whatever they call it) on the wall.

I believe the day is near at hand when no hand-made material will be allowed to be used on any building in the city of Toronto, and that the architects and engineers will specify prepared goods because, as I stated above, they can be assured of 100% efficiency in the mixture.

The question of an inspector should be brought before the proper authorities to try and get a good fair-minded man appointed, one above reproach, even if it is only to see that materials are mixed properly.

How Does Brush Painting Compare With Application of Paint by Spray?

The Tests Carried Out by Both Methods Under Exactly Similar Conditions Afford Interesting Comparisons as to Their Respective Merits and Costs

At the meeting on March 22, 1921, of Committee D-1 of the American Society for Testing Materials, at Philadelphia, the chairman of the sub-committee recommended a competitive spraying and brushing test under actual working comparable conditions. Accordingly, permission was obtained from the Pittsburgh Coal Co., owners of a row of six small frame dwelling houses of uniform size and location, to have some of these houses painted by brushing and others by spraying, simultaneously. The owners agreed to supply the labor without charge.

These houses, so far as can be learned, were painted about twelve years ago. It is considered that so far as uniformity of area and conditions of surface are concerned, the houses were practically identical.

All of the leading spray apparatus manufacturers were asked to participate and the invitation was accepted by W. N. Matthews and Brother, The DeVilbiss Manufacturing Co. and the Paasche Air Brush Co. The Spray Engineering Co., Boston, and the Eclipse Air Brush Co. did not wish to participate in the test. On account of some mishap which occurred in shipping the machine, the Paasche Air Brush Co., was unable to get their machine in operation in time to participate; but with the DeVilbiss Manufacturing Co. and W. N. Matthews and Bro., together with a non-union group of three painters, and a union group of three painters, the test was started on Tuesday morning, October 8, with four houses to be painted.

A second group of union painters had been employed to do a fifth house, but when they arrived on the job and found non-union workers next door, they refused to work, but it was considered that with two of the leading spray apparatus manufacturers and a union and a non-union crew of brush painters, there would be sufficient data from which to draw conclusions.

The color scheme for the painting was as follows:

Body of houses, gray—2 houses sprayed, 2 houses brushed.

Trim, white—4 houses brushed.

Window sash, black—4 houses brushed.

Paint Specifications

The committee decided on Bureau of Standards inter-departmental white paint conforming to specification No. 89.

White lead	31 per cent
XX zinc oxide	25 per cent
Silicate of magnesium	6 per cent
Raw linseed oil	32 per cent
Japan dryer	6 per cent
	100 per cent

The paint on the above formula was made up by W. W. Lawrence & Co. and sent in 5 and in 1-gal cans to the job. After consulting the practical painters and considering the recommendations of the spray workers, it was decided that the gray paint for the body of the house in its original form was too heavy for both brushing and spraying, and in order to get a comparison between brushing and spraying with exactly the same mix of paint, a gallon of turpentine was added to each 5 gal. of paint used for the first coat, and thus the same paint was used by both brush and spray workers. To the white trim paint for the first coat, 1 qt. of turpentine was added to each gallon.

For the second coat, ¼ gal. of turpentine was used to each 5 gal. can of gray paint; and ½ pt.. of turpentine to the white for finishing. The figures given in the report and all data which follow represent the paint as thinned for use in this manner, and to this extent, corrections must be made in the above formula No. 89 to ascertain the exact nature of the paint applied for each coat.

As cost of these paints, a price of $2.50 per gallon was agreed upon as a fair market price, and this figure is used in all calculations.

As a means of scaffolding the buildings, it was decided that the Bauer safety ladders would be satisfactory, and accordingly the Bauer Manufacturing Co., Wooster, Ohio, kindly consented to load sufficient ladders and planks for the work.

Each house was started independently as it was not found practicable to start the work simultaneously. The scaffolding apparatus was lying in the yard and the time of placing the ladders and planks in position was included in the working time.

Each house presented an area of 1,750 sq. ft. for each coat, which included the porch, but did not include the windows. All calculations on the tabulated statements herein employ 1,700 sq. ft. after making allowance for the windows.

Details of Work

House No. 1, Non-Union, Brush.—

Paint brushed by three non-union men. The old paint was badly checked. The men employed on this job worked about as fast as the average good hand brush man would. This job was about as good as House No. 3.

House No. 2, Spray, W. N. Matthews and Brother.—

Old trim was dark red. The body of the house a dirty light drab. A fairly heavy coat of primer was applied with both spray and brush; the primer did not seem to fill the bad spots thoroughly. The surface was not thoroughly wire brushed. Where surface was hard, that is, where paint was not all off surface, a few runs showed.

None of the three workers on the second coat were good brush hands. The spray did not fill in bad spots, especially where the old paint was badly checked or weather beaten.

House No. 3, Union Men, Brush.—

This job was probably the best of the four houses.

The work was very good, because the workmen were experts and the house was scraped and sanded and in fair condition for painting. It had a solid coat.

House No. 4, Spray, DeVilbiss Manufacturing Co., Toledo, Ohio.—

Old trim was dark red. A very light priming coat was applied, apparently in many places insufficient to properly seal the surface. The application appeared rather uneven, too light in spots and slightly heavy in others, but with no runs or sags. It took 9 minutes to make connections, erect staging and clean up. It took 30 minutes to do the east side, 29 minutes to do the west side and 44 minutes to do the back. Two men were used on this job. The surface was not cleaned as well as it should be for good painting The first coat was not as dry in places where paint was applied heavy as it should be for re-coating.

Conclusions.—

1. The hand brush application undoubtedly showed a superior evenness and penetration in the cracks and crevices of the rough surface. Brush application proved superior to spraying where a surface of this kind is to be contended with; therefore, having this in mind a subsequent spray test was made on one of these houses having the same rough surface. A few minutes after the paint was sprayed it required only a few minutes, by means of a 4-in. brush, to brush the sprayed paint so that it filled the cracks and crevices, and had the same appearance as the paint applied entirely by brush. It required an astonishingly short time to level off the paint in this manner and get the same effect with sprayed as with brushed paint.

2. This test developed the fact that for small houses of this character, where it is necessary to paint the body one color and the trim in another color, the spray does not show as great economy in application as one would expect, but against this is the fact that both crews of brush painters worked very rapidly, one crew especially, at a rate of speed that would hardly apply in regular practice. Also the time included in working time required to connect up the spraying equipment and clean up the outfit afterward are items which assume considerable importance on a small three-hour job, while on a larger job this item would be negligible.

3. If the houses had been painted all one color over the body and trim, the spray apparatus manufacturers would have made a much better time and cost showing. In the case of House No. 2 (W. N. Matthews & Brother) the trim color was applied by inexperienced brush painters and if it had not been for this, we believe House No. 3 would have made a still more favorable showing as to time and cost.

4. We believe Tables I and II afford reliable figures as to the cost of paint and labor per square foot between brushing and spraying where the conditions were all unfavorable to the spray method. We believe these figures afford a reliable basis for painting calculations and that they will prove valuable for comparisons in further work. The number of square feet to the gallon of paint consumed on the four jobs ranging from a minimum of 257 sq. ft. per gallon to a maximum of 425 sq. ft. per gallon, should be noted particularly.

5. Contrary to our expectations, apparently no more paint was used in spraying than in brushing. The two spray outfits used less paint than the two brush crews, and the finished houses show a difference in appearance in proportion to the paint consumed.

6. Although seven months have gone by since this test was completed, there has been no formal inspection to report on the weathering of the paints. Formal inspection will take place in October, 1922, after one year's exposure. An informal inspection made seven months after the test was completed shows all of the paints in about the same condition.

7. Having completed the test with regard to small houses and rough surfaces, the committee believes that the next test should be on larger and smoother surfaces, and the results calculated over a period of several days of working rather than for one short task.

Comparative Test of Interior Painting on Cement Plaster at Carnegie, Pa., October 12, 1921

Three identical wall spaces of soiled and unpainted cement plaster in a large hall in Carnegie, Pa., were marked off; each having an area of 205 sq. ft. On space No. 1, two expert brush men coated the surface in 17¼ minutes. On space No. 2, one spray man (Matthews) coated the surface in 12½ minutes and on space No. 3, one spray man (DeVilbiss) covered the space in 12 minutes. Both of the areas sprayed showed considerably better hiding than the brushed space. The brush men worked at extreme speed.

On the ceiling work, two men, one using a Matthews Gun and the other a DeVilbiss, sprayed 3,400 sq. ft. in 2 hours and 15 minutes.

Taking the ceiling and wall work together, 4,000 sq. ft. were sprayed with 29 gal. of paint, one coat, giving much better hiding than the brush work.

The paint used in this test was very heavy flat wall finish in white. This test developed that it is possible on this class of work to get much better hiding with the spray than by brushing, for there is less rubbing up of the dust and dirt into the wet paint; moreover, more paint per coat can be applied with the spray than by hand brushing.

New Method of Paving Bridge Floors

In order that the probability of fire on the great Victoria bridge, Montreal, Que., might be reduced to a minimum, it was decided in reconstructing the floor, to surface it with two inches of sheet asphalt. In addition to reducing the fire hazard, the maintenance cost, as compared with the old wooden floor, has been greatly reduced. This novel method of treating a bridge floor is proving quite popular in Canada.

To provide for the effect of vibration of the bridge and also for the effect of heavy traffic and weather, an unusually dense mixture of asphalt was adopted, care being taken to lay it with sufficient resiliency to meet the traffic conditions. Consequently, a high percentage of bitumen for plasticity and a maximum amount of filler for stability was specified. After a good deal of experiment it was found that 13 per cent of asphaltic cement was excessive and finally 11.6 per cent was adopted. The new bridge floor has now been giving excellent service for two years without additional cost for maintenance.

Machines for Pipe Laying

In 1920 the New Bedford, Mass., Water Department had about 6,600 ft. of 36-in. cast-iron main to lay in addition to the ordinary extensions. As labor was scarce, it was decided to purchase a 14B Bucyrus steam shovel with an extended dipper arm for trenching, and in 1921 when the 48-in. cast-iron main was started a 14B Bucyrus clamshell and derrick machine with a 30-ft. boom was bought. These machines have proved great money savers on the large pipe work which has been done in the past three years. The latter machine is used for pipe laying, and in places where the ground is too soft to support the steam shovel over the trench, excavating is done with the clamshell outfit on the same machine. Under ordinary conditions the excavation is done by the steam shovel travelling on platforms over the trench with the derrick following close behind, laying the pipe. The shovel deposits the excavated material into trucks which haul it directly to the backfill close behind, or to the spoil bank.

With reasonably good conditions from 120 to 180 ft. of trenching, pipe laying and backfilling per day is accomplished with a crew of from 15 to 20 men, two or three trucks, and the steam shovel and derrick. The advantage of a small crew is particularly great in our present work, which is ten to twelve miles from the city, requiring that the men be boarded near or transported to and from the job. —Stephen H. Taylor, Superintendent of water works, New Bedford, Mass.

The Western Clock Co., Ltd., Peterborough, Ont., expect to have their new factory completed by October 15. The main building will be 4 storeys high and 160 x 50 ft., built of reinforced concrete faced with red brick and artificial stone. The power presses, stores and heavy manufacturing will be on the ground floor. The miscellaneous department will occupy the 2nd storey. Assembling, regulating, finishing and packing will be carried out on the 3rd floor, while the 4th floor will be devoted to rest and recreation rooms, restaurant and laboratory. A second building takes care of the plating, buffing, tumbling and lacquering departments.

Some Lessons From a Big Exposure Fire

The Destruction of the Burlington Building, Chicago, Affords Some Valuable Information Regarding the Fire Resistive Powers of Various Materials and Types of Construction

In the "Contract Record" of April 26 appeared an article dealing with certain features of the remarkable fire which destroyed the sixteen storey office building of the Chicago, Burlington and Quincy R. R. in Chicago on March 15. As a result of further study and investigation, many new facts have been brought out concerning the conflagration and fire hazards in general.

Most prominently, perhaps, the serious exposure danger to which modern fireproof office buildings are subjected because of absence of window protection was for the first time brought clearly into view. A summary of the teachings of the fire based on a thorough study has been prepared by A. R. Small, vice-president of the Underwriters' Laboratory, that part of his summary which is of most direct interest to the structural and fire-prevention engineer being reproduced herewith.—

The "Q" Building, erected in 1913, was used for the general offices of the Chicago, Burlington & Quincy R.R., its owners. The occupancy throughout the burned floors was a typical office occupancy. The contents were wooden desks and chairs, sheet-metal filing cases, and shelving and paper records of various sorts in and on desks and in the filing cases and elsewhere. Practically no special hazards were present and there was no unusual storage of combustible contents.

The building is of U shape with the closed end to the north, on Jackson Blvd., with a height of 195 ft. and an area per floor of nearly 23,000 sq. ft. It was of steel skeleton or cage construction, with inclosure walls having windows occupying a large proportion of each bay space.

The Clinton St. and Jackson Blvd. fronts were finished with glazed white terra-cotta of somewhat elaborate design; the west and south walls and the walls of the court (which opened to the south) were finished with light glazed terra-cotta brick. Window frames on the two streets, in groups of three, were of wood with wood sash and plain glass, except that on Clinton St. at an outside iron fire escape of the balcony-and-stair type one bay of each floor had hollow metal frames and sash, the centre ones with over-sized lights of wired glass. The numerous window openings at all floors in the west and south walls were each equipped with a hollow-metal window frame and sash with wired glass. The court window frames were mostly of wood with wood sash and plain glass. The floor arches were of hollow tile. side construction, 3-cell, 15 in.; in the 10th, 13th and 15th floors there were superimposed on them 20 in. hollow tile (3 in. thick, on edge) laid on 4¼ in. cinder concrete, to accommodate reinforced concrete ventilation ducts.

Protection of the Steel

Horizontal members of the steel frame were protected with hollow tile according to general practice. The columns were protected with 3 to 4 in. of concrete, and in some cases with 3 in. tile in addition. Corridor and room partitions were of 3 in. hollow tile, with trim, transoms, doors, frames and bucks of wood. All interior wall and ceiling surfaces had plaster finish without furring except in the president's offices. Considerable marble trim was employed in main corridors and elsewhere on each of various floors.

The main passenger elevators, in two opposite banks, had cast-iron grill doors and fixed panels with wired-glass lights of small area (about 10 x 18 in.) Adjoining to the west was the principal stair shaft, with hollow metal doors in pairs at each floor, each door with upper panel of wired glass in two lights and a hollow metal transom with four lights of wired glass. The door frames and bucks at these openings were of steel. The same equipment was provided for the other stair shaft in south-east corner.

Vaults for storage of records were located on each floor adjoining the east bank of elevators. They had double walls on three sides of 4 in. hollow tile with a 6 in. centre space filled with broken tile concrete. They had the usual vault door equipment consisting of an outer single swinging door of steel plate with heavy bolts and inner steel plate doors in pairs, recessed in an iron frame 20 inches deep.

The vaults on each floor when opened were found to have preserved their contents, their being practically no damage in any of them from either fire, smoke or water. Similarly the 3-in. tile enclosures of the ventilating and air washing machinery prevented entrance of fire or excessive heat. Elsewhere everything combustible was consumed on floors 10 to 15 inclusive. Tile partitions mostly fell, and if not down were insecure; the plaster finish largely fell; the wood flooring and nailing strips burned out from the 9th to the 15 floor.

Stair Shafts Secure

The hollow-metal doors prevented entrance of the fire into either stair shaft. Some blistering of paint within the shaft from radiation took place but the stairs were capable of accommodating people either for exit or refuge or for fire fighting during the entire period of the fire. Had the transoms been omitted and also the wire glass in the upper panels of the doors, there would be no material evidence in either stairway that a fire had occurred.

The cast-iron frames to the openings at the elevator landings warped badly but the wired glass because of the small dimensions employed quite generally remained in place. The elevator equipment was not seriously damaged and was in use within 24 hours. The absence of furniture and other combustibles in the immediate vicinity of these elevator doors no doubt had a substantial bearing in this result.

Wired glass in the hollow-metal frames and sash in the west wall collapsed very generally, due to the high temperatures reached on the various floors. The frames and sash do not show material distortion. Many of the lights of wired glass in hollow-metal frames and sash in the south wall (not in the court) were still capable of resisting passage of flame following the fire.

The terra cotta tile on the north and east exterior walls was badly damaged. Appearance and public safety required its removal from the 8th floor level to the cornice. Of interest is the spalling of projecting ogees, and other ornamental details. These parts in falling added to the glass shower which hampered the work of the department on the sidewalks below in the early stages of the fire.

Columns, Beams and Floors

The concrete served fully to protect the steel columns in every case. Paint on the steel was not softened. Only surface dehydration of this concrete occurred and this was not universal.

Generally speaking the soffit tile similarly protected the steel floor beams and girders, although they were observed to have fallen from a single beam in the 12th floor at the south end of the west wing and from another in the 14th floor at the centre of the east wing. There are a few spots on various floors where the soffits of the floor-arch tile have fallen. The plaster fell so generally on the 10th and 14th floors that crack in soffit corners in arch tile may be common. The cinder concrete fill was dehydrated only very slightly; its insulating value was hardly impaired.

The T-bar mullions in the street front and other triple window openings warped, generally outward near the upper end. There was no provision for their expansion. The terra cotta and tile casings for these mullions failed and fell in many cases. The steel lintel plates in these openings show but little evidence of warping.

The service equipment, such as steam piping, electric conduit and water piping is not materially damaged. There was heat in steam radiators on all floors a day or two after the fire.

The roof covering, which is of flat tile embedded in pitch or asphalt, is not damaged. The projecting cornice deflected the heat wave so that the roof was not exposed.

The east wing was 16 stories high without windows or other openings in the 16th floor. There was no fire damage on this floor.

Lessons of the Fire

If the "Q" Building had been of seven stories or less it would have suffered little damage comparatively from the exposure to which it was subjected. This single-building loss duplicates on a smaller scale the circumstances of the Baltimore and San Francisco conflagrations, the particular lesson of which was the horizontal spread of heat waves at high levels.

Fire exposure in the case of high buildings exists at distances much in excess of the 50-ft. maximum now recognized by many organizations, or the 30-ft. limit of most building codes. Street widths or other clearance must exceed building heights by perhaps 100% for a severe fire exposure hazard to disappear even when only moderate winds are considered. Unprotected window openings invite similar burnouts in so-called "fireproof" buildings wherever severe fire exposure exists.

Wired glass in areas not exceeding 720 sq. in. and mounted in metal frames would probably have prevented entrance of heat wave into the upper floors. In any event it would have delayed its entrance for a considerable time. If, in addition, window sprinklers had been provided and used, wired glass in standard metal frames perhaps even with lights greater than 720 sq. in. would have prevented entrance of the heat wave into the building and probably would also have materially lessened the damage to the terra-cotta exterior finish.

The stairway enclosures functioned nearly 100% and fire did not communicate from floor to floor within the building.

Wired glass in doors, transoms or elsewhere in stairways and other enclosures to vertical openings should be avoided; when used, it should be in small lights, not exceeding 10 x 15 in., and these should be as few as possible.

A horizontal cut-off equivalent to a 1½-hr. fire division wall would have confined this fire to the east wing..

It is clearly wasteful to erect partitions of fire-resisting materials and then to equip them with combustible trim at doors and transoms. The only possible advantage is the reduction of the quantity of fuel, which advantage was of no account in the "Q" Building fire.

Wired glass cannot long withstand temperatures reaching 1,200 deg. F. on both sides or 1,700 deg. F. on one side. At these temperatures it softens so that its weight pulls it from the sash grooves.

The average fire temperature in the "Q" Building did not exceed 1,800 deg. F., if indeed they reached this point. The ruins suggest a fire of a severity not greatly exceeding the conditions obtained in a 1½ hour test.

Single-cell hollow-tile partitions will not remain in place when subjected to the expansion stresses set up by a fire exposure such as prevailed here and subjected to the forces of sudden cooling and impact from hose streams.

The 3 to 4-in. concrete on the steel columns provided ample fire protection for the exposure which was obtained.

Terra-cotta exterior finish, as employed quite generally in Chicago, is subject to spalling and other material damage from the heat of exposing fires of any intensity or duration. Most other materials of value from a decorative point of view are subject to similar damage to some degree.

Wood furniture and trim and similar combustible material of a "fireproof" building not only are subject to total loss but add fuel to the fire.

The single-wall steel filing cases failed completely to protect their contents.

Automatic sprinklers probably would not have controlled the fire, but very likely would have done so if all the window openings had been protected with standard fire window frames with wired glass.

The rolling steel shutters in the court windows at the 10th and 15th floors at the ventilating machinery rooms prevented passage of flames. The heat radiated from these shutters blistered the paint on both sides of steel partitions at least 18 in. behind the shutters.

The vaults preserved their contents. They were subjected to a moderate fire exposure. The paint on the inner doors blistered. With a mercantile or industrial occupancy including stocks of combustible goods and a complete burnout such as occurred in this building, such vaults would be likely to fail from radiation through the iron doors.

River Improvements in Windsor

Merlo, Merlo and Ray Are Building a Concrete Dock on the Detroit River

Improvements are being made to the newly acquired riverfront property of Merlo, Merlo and Ray, in Windsor, which, when completed, will represent an expenditure of over $100,000.

The company is having constructed one of the most modern concrete docks in the Border Cities, 227 feet in length, and having a twelve foot width. The dock, when completed, will permit the tieing up of the largest lake freighters, and will be separated by only a short distance of river frontage from the fine cement docks of Hiram Walker and Sons, Ltd.

Work is being carried out by the Detroit River Construction Company, which has a permanent force of 15 men on the job. The company is now completing heavy piling across the 227 foot frontage, preparatory to filling in on the land side with rock and other material secured from torn up streets in the Border Cities now being repaired by Merlo, Merlo and Ray.

The latest type of wharf construction equipment is being used in the big job, which is under the personal supervision of G. A. Guyer, manager and superintendent of the Detroit River Construction Company. A huge driving scow, 26 by 56 feet, having a three foot depth, is being used. Piles are sunk to a depth of from 25 to 30 feet by aid of the 60 foot leaders on the driver. A large air hammer is used to drive bolts, run pneumatic augers through the piling and do other work where a large force of men would have to be employed to carry out the improvements by former methods.

Starting next week, a land pile driver will be employed to set anchor piling 60 feet back from the river front. This land piling will tie the wharf piling every six feet by inch and a half steel rods, excavating for the laying of these are now being carried on.

In the construction of the wharf, all river piling will be cut off two and a half feet below the water line and a three inch plank floor laid over the same on which seven feet of concrete will be poured. This construction will allow for a concrete dock five feet above the water line.

Discuss Town Planning Laws

The Western Ontario United Boards of Trade opened an interesting one-day session at the Prince Edward Hotel, Windsor, recently, for the discussion of legislation affecting municipalities. The chief business was the discussion of a town-planning act to be presented to the Legislature, which, it is hoped, will grant more power to town-planning boards throughout the province than these boards now possess.

The consensus of opinion of those present was that town-planning boards in the various municipalities should be given wider power. The Hill bill was discussed and recommendations of Mr. J. M. MacAdams considered. These were explained by J. Clarke Keith, who has been actively identified with town planning matters in Windsor.

Mr. Keith pointed out that at present the town-planning boards had no funds at their disposal. He cited the case of town-planning in Windsor and stated that when an attempt had been made to prevent real estate lots being sold at less than 35 foot frontage, the local town planners had been overruled by the Ontario Railway and Municipal Board. This was one particular matter that should be rectified, he said.

Other matters to be embodied in the proposed bill were designs of buildings and the setting aside of 5 per cent. of all sub-divisions for park purposes.

A Hamilton Booster

The city of Hamilton, Ont., has issued a very attractive booklet entitled "Hamilton the City of Opportunity—745 Diversified Industries." The booklet is a product of Mr. C. W. Kirkpatrick, commissioner of Industries and Publicity. It is well isssutrated and marshals in a very forceful way the advantages of Hamilton as an industrial centre. Among other advantages, Hamilton claims to have the cheapest electric power in the world.

The prices of building supplies in the Toronto district this week continue practically stationary, the only changes noted being a drop in the price of boiled linseed oil from $1.12 to $1.06 per gal. and in raw linseed oil from $1.10 to $1.05; and an increase in turpentine from $1.85 to $2.00 per gal.

The Slump Test

Do you know that the slump test is the simplest and most practical way of determining the proper amount of water to use in mixing concrete? The correct cement-water ratio for any concrete mixture will develop the maximum strength of the concrete. A knowledge of how to determine this ratio is a matter of importance to the builder.

The slump test is a simple, easy, and practical method of making this determination. The only apparatus necessary is a special mold, made from sheet metal, preferably non-corrosive, in the form of a frustum of a cone 4 inches in diameter at the top, 8 inches at the bottom, and 12 inches in vertical height.

After thorough mixing the concrete is placed in the mold in three or four successive layers, each layer carefully puddled or rammed with a blunt-pointed 5/8 inch round rod. The metal mold is then removed with a steady, vertical lift, leaving the concrete free to spread at the base. The "slump," or reduction in vertical height of the pile of concrete which results, is an indication of the consistency of the mixture.

The consistency which produces concrete of maximum strength is known as a "normal" mixture, and has a slump of about one inch. A reduction in the amount of water of 10 per cent. below that required for a normal mixture will change the slump to only one-half inch, and decrease the strength of the concrete about 30 per cent. Increasing the water 10 per cent. above normal will result in a slump of almost three inches, and a loss of at least 15 per cent. in strength.

A portion of the strength of the concrete must sometimes be sacrificed in order to obtain the plasticity of mixture required by the manufacturing processes employed. For pavements, floors and large foundations, the slump should not exceed 3 inches. For thin, reinforced concrete walls where smoothness is required but compacting is difficult, a mixture with a slump of 6 or 7 inches is permissible because its wet consistency practically eliminates the necessity of tamping. Remember: Do not make your mixture more plastic than is required by the nature of your work.—From the "Concrete Builder."

A New Combination Crane and Shovel

One of the most modern combined utility machines for the contractor, supply yard, railroad or industrial plant is the improved crawling tread crane-shovel manufactured by the Orton & Steinbrenner Company of Chicago, Ill. and Huntington, Ind.

Two sizes of machine are manufactured—of ¾-yard and 1-yard capacities. The design is such that in a minimum amount of time simply by removing the crane boom and substituting the shovel boom and dipper, the crane may be readily converted from a clam shell rig to a steam shovel. Even this is unnecessary to convert it into a skimmer for tearing up pavement. A separate boom with skimmer scoop can be connected to crane independent of the main crane boom and the hoist line simply reeved over the scoop. The radius of the boom instead of being fixed at a certain degree, may be varied to suit the conditions of the job. This feature enables it to dig several feet below the normal operating level and also increases the lift.

Motive power is supplied by only two engines, thus simplifying operations. The hoisting, swinging and traveling operations are performed with double clutches by the main non-reversing engines, while the crowding motion of the dipper is actuated by a separate reversing engine placed midway along the boom. The rotating base turns on a live ring of rollers on a large diameter rail circle, thus evenly distributing the load and requiring very little power to swing.

The carbody is built up of structural steel shapes and plates amply riveted and thoroughly reinforced. The housing is of sheet steel with ample sash and doors and arranged for removal when required. The operator has a clear and unobstructed view of the dipper at all times.

Orton & Steinbrenner's latest shovel

The crawling tread is of the flexible type, adjusting itself automatically to the contour of the ground. The tread links are so designed that in passing around the sprockets all foreign materials adhering to them are thrown off and prevented from entering the spaces between. All movable parts are bronze bushed and lubricated with Alemite pressure system and sheaves and bearings are bronze bushed. A feature of the machine is the accessibility of its parts, especially those bearing the brunt of the wear.

A booklet describing this machine can be had by addressing the Orton & Steinbrenner Company, 608 South Dearborn Street, Chicago, Ill.

Handling Builders' Supplies

Messrs. Mercer Bros., formerly of Islington, Ont., have purchased the business of John Cunningham at Cooksville, Ont., who for twenty years carried on trade at that point. Mercer Bros., have made addition to the business and are now in a position to cope with all the requirements of the contractor in the lines of builders' supplies, lumber, coal, hardware, etc. They have ample delivery conveniences, insuring prompt and efficient service; sole agents also for White Rose gasoline.

A new building 84 x 100 ft., of brick and stone construction, is being erected by Richardson, Bond & Wright, Ltd., at Owen Sound, Ontario.

Leadite Joints Prove Satisfactory

Experience in One Town Demonstrates the Superiority of Leadite for Water-pipe Joints Over Hydrotite and Lead—The Cost is Much Lower

Water works officials are always interested in the relative merits of jointing materials, particularly substitutes for lead. The experience of New Bedford, Mass., in this connection is of special value and it is therefore worth while to read the results of tests carried out in that town as they are described by Stephen H. Taylor, water works superintendent, in a paper presented at the recent meeting of the new England Water Works Association.

Some ten years ago a few joints in our smaller-sized cast-iron pipe were made with leadite and lead hydrotite. No trouble has ever been experienced with either. In the spring of 1920 I decided to make more extensive experiments with these substitutes for poured lead joints.

At that time leadite was offered at 12 cents per pound and lead hydrotite at 10 cents, while lead was selling for about 7½ cents per pound. One pound of either substitute would fill as much joint space as 4 lbs. of lead, so that it would take 30 cents worth of lead to do the same work as 10 cents worth of hydrotite or 12 cents worth of leadite. There is also a further saving in the reduced labor cost, because no caulking is necessary, and the size of bell holes is greatly reduced. The only chance of skepticism, then, was as to their efficiency. As the contemplated work involved a considerable amount of jointing material, the 2 cents per pound difference in cost of leadite and hydrotite was worth saving if the two materials were equally efficient.

Tests With 6-in. Pipe

Six lengths of 6 in. pipe were put together on skids about 2 ft. high, with plug and sleeve on one end made with lead and a patented plug in the other. Three joints were made of leadite and three of hydrotite. Dry white jute was used in its different forms. One joint with each material was made with loose yarn, one with the same yarn twisted lightly, and a third with the same yarn braided.

The pipes were first filled at city pressure (84 lb.) and the joints were all reasonably tight, the greatest leak occurring at the joint made of leadite with loose yarn. There was also some leak at the joint made of hydrotite with twisted yarn. The pressure was then raised, first to 150 lb. and then to 200 lb., all joints remaining reasonably tight and becoming so with the exception of the two above mentioned. The high pressure was then released and normal yard pressure (84 lb.) maintained during the remainder of the test.

The ends of the pipe were raised by means of a derrick at each end, the supports, which were under the pipe, being removed as the pipes were lifted from them until, for a short time the line was practically suspended by the ends, forming a curve with about 144 ft. radius and the ends of 5 ft. 9 in. higher than the center. Finally joint No. 5, hydrotite, broke, allowing the center of the line to drop to the ground. It should be said, in fairness, that the joint which failed was not made with a continuous pouring, because some of the material was lost through a defective dam and a second pouring was necessary. Only a few seconds elapsed between the first and second pouring, however, as the kettle was close to the joint and it was only necessary to dip out more material. The whole line was then lowered to the ground and remained tight except the two joints before mentioned (Nos. 2 and 5.) These were made tight by caulking with a little lead wool, and for several months the line remained in the yard absolutely in tight condition, in spite of the abuse to which it had been subjected.

Experiments With 36-in. Pipe

As the principal work of the year was to be 36 in. pipe, it was thought advisable to experiment with this larger size to see if it could be successfully poured. Two lengths of 36 in. pipe were joined, with a plug in one bell and a sleeve and plug on the spigot end. Accidentally a class B pipe, N.E.W.W. specifications, was placed into a class F bell. This made an unduly thick joint (about ⅞ in.). The class B bell was too small to receive the beaded end of the plug, so the plug was reversed. This made an abnormally thin joint with no bead, as the space was so small that it would have been impossible to caulk a lead joint. These joints were made with leadite. On the other end the sleeve and plug were normal ½ in. joints and were poured with lead hydrotite.

When the yard pressure was applied, in spite of the bracing at the ends, the joints between the two pipes slipped about ¾ in. This was the abnormally thick joint. The 84 lb. yard pressure on the 36 in. plugs developed a total stress on each of them of about 42½ tons. The braces were then removed and the pressure applied with the intention of pulling the work apart. When this was done the two abnormal joints made with leadite held fast, and the one where the sleeve joined the pipe, which was a normal ½ in. joint made with hydrotite, pulled apart.

As a result of these tests, it was decided to adopt leadite for our work, and it has been used in practically all the joints made since that time with excellent results.

Recently a very favorable opportunity was presented for comparing the cost of 48 in. joints made of lead and leadite, as two joints were made of lead on the check valves of our 48 in. line, because of the extreme weight of the casting and uncertainty of the ground in which it was placed. Figuring the cost of jute packing, labor and lead, a 48 in. joint cost an average of $4.42. It took three men 1 hr. and 40 min. to pour and caulk a lead joint, whereas the same three men would average to pour from six to eight joints per hour with leadite.

In November the 62 x 50 ft., 3-storey addition for Turner Bros., Peterborough, Ont., will be completed. The new building is intended for storage purposes.

A New Type of Road Drag

A new type of road drag has been devised by the Road Maintenance Department of the Iowa State Highway Commission, the plans having been prepared by O. M. Briley of the Maintenance Departmment and the first sample having been built by mechanics at the warehouses and machine shop of the Highway Commission. The drag was given its first tryout on the roads of the Iowa State College at Ames and in May started on a tour of the state. Boone county and possibly others have constructed similar drags from unused material lying in its storage piles and warehouses. This is the description of it as it is given in "Public Works."

The commission believes that every county store yard contains wheels and axles, beams and miscellaneous material that is rusting away but which, with a little ingenuity and labor, can be put to use by the Road Department, and it is with the idea of suggesting probable ways of utilizing this unused material that the Commission had this machine put together.

The material used were a pair of old War Department gun caisson wheels with an axle, some eye beams, two or three lengths of cable, two lifting jacks and a small cable drum, almost all former War Department materials. With this combination of material a wheeled road drag was constructed that is heavy enough to do on soft dirt roads some of the work usually done by a blade grader. It is designed to be drawn behind a heavy truck.

The drag consists of two 16-foot channel irons extending longitudinally on the outside of the frame, and two 22-foot channels placed parallel to and equally spaced between these. Three angle irons, each approximately 16 feet long, are fastened under these four longitudinal channels, each with one angle vertical and the horizontal angle on top and fastened to the bottom flanges of the channel irons. Two of the angle irons are set at similar angles to the longitudinal channels, one at each end of the frame, while the third is set diagonally between these and sloping in the opposite direction from the longitudinal axis of the drag. These angle irons are so attached in the frame work thus built up that the two outside ones work the dirt towards the centre of the road when the drag is in use, and the middle one works it towards the outer edge. The result of this arrangement is that the front angle iron throws the dirt towards the centre of the road, the middle blade, which extends a short distance beyond the inner end of the front drag, picks up the material and works it back again towards the outer edge; while the third or rear blade, which extends further towards the gutter than the centre blade once more throws the dirt back towards the centre. This criss-cross motion to which the material is subjected aids materially in filling small holes and ruts and crushing clods. A sawtooth bar is hinged loosely on the end of the central blade that is nearest the side of the road and acts as a clod or stone remover, all clods that are not crushed and all small stones that are too large to be pressed into the surface being thrown to the extreme outer edge of the roadway and entirely clear of the travelled surface. This bar can be raised entirely out of contact with the surface if desired. It works loosely on a bolt and is provided with a spring, so that if it catches on any obstruction it will yield until dragged by and then spring back again into place.

This frame is dragged behing the truck. In addition to the frame work just described, a pair of wheels and axle are attached by chains to the side channels of the frame so that the wheels rest on the road between the middle and rear angle irons and inside the outside channels. The driver rides on a seat fastened on this axle. In addition there is on the axle a small drum carrying a cable which is attached to the frame, by which the frame can be lifted from contact with the road when it is desired to travel rapidly from point to point without operating the drag.

It is claimed that while it requires a skilled man and constant attention to run an ordinary road drag effectively, almost any one can operate this one successfully, for it automatically takes care of all the variations in the road surface, the long base and criss-cross motion tend to carry the dirt forward from high spots and to fill in low places, and there is no tendency at all to gouge in where the soil is soft or where there is a low spot. New material deposited on the road is picked up easily and slid along for a considerable distance, giving it an even distribution.

Preservative Treatment for Timbers

From the fact that about 2.900 ties are necessary for a mile of main track the enormous number of railway ties in use in Canada may be roughly computed—one hundred million may be considered a modest estimate. Of this hundred million from fifteen to twenty million must be replaced annually, mainly on account of decay. This replacement represents a considerable proportion of the cost of railway maintenance. The railways must go farther afield every year to obtain ties, and putting them into the track is costly. It is also a great drain upon the forest resources of the Dominion.

Such an expense to the railways and loss to the Dominion have not been stoically accepted by either railway of Government executives. The Department of the Interior has not only given the situation serious consideration but has conducted active research since 1913, with a view to its amelioration. This research has been mainly directed towards the prolongation of the "life" of ties by preservation treatment, and has been conducted at the Forest Products Laboratories. This institution, which is under control of the Forestry Branch, includes a division of wood preservation, staffed by specialists, and provided with equipment for the experimental preservative treatment of timbers. As a result of the work at these laboratories, suitable methods have been developed for the preservation of the principal tie-woods of Canada; and the application of these methods on a commercial scale is being made at plants where railway ties are treated in quantity. The railways have realized that their annual expense for ties can be reduced nearly one-half by suitable preservative treatment, and have encouraged the development of a wood-preserving industry which now consists of six large plants in Canada.

Railway ties are not the only timbers which in the past have been wasted by being allowed to decay. The application of preservative treatment to poles, posts, silos, piles, and other timbers presents great possibilities. These, if realized, will effect a notable conservation of the timber resources of the Dominion and a considerable economy in the administration of its railways and public utlities.

How Slag-Concrete Roads Stand Up

A Study of the Concrete Highways in Which Slag Has Been Used as Aggregate Shows That They are in the Main as Good as Those Using Natural Aggregate

Slag as concrete aggregate has been used for concrete roads for about nine years. In some places it is the most economical and easily obtained aggregate, but many engineers and contractors are not acquainted with its use or fear its wear. "Engineering News-Record" in a recent issue devotes an article to a study of slag concrete roads, their construction and wear. The study is the result of an extended observation of slag concrete roads under construction and in service. The conclusions are that while there are certain peculiarities of slag both as to manipulation and wear, concrete roads with it as the aggregate are in the main in as good shape as those using natural aggregate. The article follows:—

About 225 miles of slag concrete highways are in service in the United States. Practically all of this road has been constructed in six states, Ohio, Pennsylvania, Georgia, Indiana, New York and West Virginia, and a very large proportion of the mileage is county road. Ohio leads all other states with between 90 and 100 miles of slag concrete pavement dating from 1913 to 1921. All of these pavements are in service and considering their ages, the practice of the time and the maintenance they have received they exhibit no greater structural deterioration than is common to concrete roads of comparable age and construction in which stone or gravel aggregate was used. Surface imperfection in the form of pitting is almost invariable in slag concrete roads of any age which has permitted some amount of traffic wear and weather action to take place.

Slag is a compound of the impurities in the iron ore and of the limestone used as a flux in blast furnaces. It comes molten from the furnace and when it is intended for crushing it is poured in relatively thin layers on slag banks and allowed to cool. The cooled slag is excavated, crushed and screened for commerce. Crushed slag is a hard though very porous material, and makes an aggregate of considerably less weight than gravel or crushed stone. Offering a rough pitted surface for the adhesion of cement it produces a strong concrete. The larger producers take great care in selecting and curing the slag and in crushing and screening it for concrete aggregate.

Slag is an available aggregate in a number of states where steel manufacture is extensive. In sections of these states it can be laid down in stock piles for road construction at less cost than can stone or gravel aggregate. It is, therefore, in these localities a commercially logical aggregate for concrete roads. The only question of its utility is whether it gives as serviceable a pavement which can be constructed with no increased difficulty because of the nature of the aggregate. There are varying opinions on both points.

It is probably not unfair to assert that generally the fitness of slag as an aggregate for concrete roads is regarded with a shade of doubt and in specific instances with actual distrust.

It is also generally assumed that pavement fabrication of slag concrete is more of a care than it is with gravel or stone concrete.

Specifications

Very few state highway departments provide specifically for slag as an aggregate for concrete roads and in these the specifications vary greatly in their quantitative provisions. Ohio has perhaps the most precise requirements. They are as follows:—

The broken slag shall be clean, sound, durable, reasonably uniform in density and free from thin or elongated pieces. The chemical composition shall be not less than 32 per cent. silica, not over 45 per cent. calcium oxide and not over 1½ per cent. sulphur. The slag shall show not over 10 per cent. wear by the stone test or 20 per cent. by the gravel test; have a toughness of not less than 5, and weigh not less than 70 lb. per cubic foot. It shall show no signs of checking, cracking or disintegration in the sodium sulphate test for soundness.

Colorado calls for a 78-lb. slag and Pennsylvania for a 75-lb. slag. These weights virtually eliminate all but a few slags which can be produced commercially. In general a 70-lb. slag, as specified in Ohio, can be produced from most slag banks without excessive picking and choosing. Most slag concrete roads and pavements of county and town construction have been built of slags weighing between 65 and 70 lb. per cubic foot.

Practice with respect to pavement sections and proportions does not differ essentially from that when stone or gravel concrete are used. The more recent sections are 5-7-5 in. and 6-8-6 in. in thickness and from 16 to 20 ft. wide. Older roads show various widths down to as narrow as 9 ft. and thicknesses of 5, 5½ and 6 in. Proportions vary in different states but run curiously uniform in all parts of the same state. In Ohio all but 8 of 44 sections are a 1:1½:3 mixture. In Pennsylvania a 1:2:3 mixture is nearly universal and in the south, Georgia and Alabama, it is nearly always 1:2:4. The size of slag runs from ⅜, ¼, ½ and ¾ to 1½ in.

While the proportions given are the nominal proportions, actually, in slag concrete paving, there is almost always some juggling of the proportions until the easiest working mixture is determined. As an example, the 18-mile slag concrete section of the Cleveland-Akron road built in 1921 was nominally a 1:1½:3 mixture and actually a 1:1¾:2¾ mixture. Generally speaking a moderately over-sanded mixture is easier to work.

Tests

Slag tests for the specific purpose of determining its qualities for concrete roads have been comparatively few. A series of investigations is now being conducted by the Bureau of Standards. Also some study of the material has been made at Lewis Institute for the Portland Cement Association. In neither case have the records been announced for publication. Standard laboratory crushing tests indicate strengths quite as great as are required for pavements in ordinary construction practice. In fact no test results of slag concrete, which are known, give reason to doubt the satisfactory physical properties of this material for pavements.

Construction

Slag is light in weight compared with rock aggregate and it moves harshly, with perhaps more friction in chutes and a greater disposition to arch and "hang up" in bins. To these two qualities are due the chief concern in constructing slag concrete roads.

Because of its light weight the slag "floats" to the top of the slab and makes a somewhat harsher surface under the finishing roller and belt. The floating particles "drag" under the belt and float and do not permit the "soapy" finish that can be got under the belt or float with a stone and gravel concrete. These obstacles to easy finishing should not be exaggerated. They necessitate more care and somewhat different methods but not much more labor or expense. It is said by contractors that "one has to learn how to handle slag but afterwards it is no more troublesome than other aggregates."

The tendency of slag to arch and hang-up requires steeper slopes and larger passages in bins and chutes. It "shovels" with a little more difficulty than broken stone but its weight is less and larger shovels can be used. It is not appreciably more difficult to dig and lift with clamshells and generally larger buckets can be employed. Compared with stone or gravel it is a clean and dustless material to handle.

To finish slag concrete satisfactorily does not require different processes and tools but different ways of using the tools and performing the processes. On the whole perhaps belt finishing is least adaptable. In addition to "pulling down the crown," an objection general to the process, the belt catches the sharp slag particles and shuttles them back and forth scoring the surface. A better tool is the float, or a thin board used like a belt but capable of being lifted and laid down and so used to press down the floating particles until the mortar submerges them and slightly stiffens around them. Machine finishing is entirely practicable to strike off and tamp the slab but not for belting. In some recent large slag concrete road operations the belt, after a brief experience, has been taken off the machine and hand tools substituted for the fine finishing.

Service

Inspection of some 20 slag concrete roads built from 1913 to 1921 and aggregating approximately 100 miles has led to the following conclusions:—

1. No disintegration of slag concrete roads certainly due to the slag content of the concrete were observed. In one instance a slag concrete base for a bituminous surface was found where many blow-ups were attributed to temperature action on concrete water-soaked because of the porosity of the "second class concrete base." Nowhere was evidence presented of any unsoundness of concrete because of any chemical content of the slag aggregate.

2. Slag concrete roads exhibit longitudinal and transverse cracking, corner breaks, shattering due to blow-ups and heaving sub-grade and heavy traffic loads, and practically every other sort of failure characteristic of paved roads but to no greater degree than other concrete pavements of corresponding ages and construction practice.

3. Most of the slag concrete roads inspected appeared at a disadvantage because of poor maintenance. These were county maintained roads. Old cracks had not been filled and corner breaks and zones shattered by heaving or other cause had been allowed progressively to develop until the pavement presented a ruined appearance which it would not have presented had repairs been promptly made.

4. Practically all slag concrete roads exhibit surface imperfection due to general pitting. This pitting is caused by the breaking and crumbling out from the mortar matrix of the pumice or light friable slag particles which come to the surface during construction. It is a curious circumstance of this condition that the small pits ranging from ¼ to ½ in. in diameter and depth left by the disappearing soft slag, do not often enlarge by breaking down at the edges. They are a defacement rather than a structural damage, as they were observed in some scores of areas minutely examined at random.

Development

The critical task in developing slag concrete pavement is to eliminate pitting and to eradicate the impression that there is some danger to concrete soundness in the chemical constitution of slag.

Pitting, as stated, is due to light friable particles, or pumice, which are a content of every slag, rising or floating to the surface of the wet mixture and then breaking up after the pavement is in service and leaving a pit in the mortar matrix. The weight requirements of slag aggregate specifications, as they are quoted in a previous paragraph, are designed to reduce the percentage of pumice. No practicable weight requirement, however, can correct the difficulty entirely without putting slag out of consideration commercially as a road concrete aggregate.

To separate the pumice from crushed slag by some mechanical process which is economically practicable is the big technical problem in slag production. There is a margin of only a fraction of a dollar a ton within which slag can compete in price with crushed stone or gravel. Any process of pumice separation to be commercially practicable must operate within this narrow margin. This limitation has so far put out of consideration any flotation or jigging process and of course screening does not meet the situation. The problem as yet has proved unsolvable.

Overcoming the mistrust of chemical troubles from the use of slag is a matter of proof and education. The proof lies in the structures built and remaining invariably sound and in the laboratory studies now in progress.

Civic Improvements in Camrose, Alta.

The Camrose, Alta., municipal light, power and waterworks, the superintendent of which is Mr. J. S. Eby, are installing a new boiler at their plant, manufactured by Goldie and McCulloch Ltd., Galt, Ont. It will be fired by stokers manufactured by the Underfeed Stoker Co. of Canada Ltd. They are also installng a feed pump in connection with the boiler, and are making the necessary alterations to the boiler house for the new boiler.

Economy of Plain and Reinforced Paving Bases Compared

The construction of a pavement foundation is far from being a simple piece of laboring work, involving the mixing and pouring of concrete. The mixing of concrete alone is a problem to which engineering skill and experience may very properly be given. A statement that the failures found in concrete pavements are to be attributed to the engineer, rather than the material, will, no doubt, be resented, but such is the case.

Laboratory tests may, and do, prove delusive if not correctly interpreted. Concrete, a sample of which in 28 days might give a compression test of 3,000 pounds or more, will frequently break up from internal stresses due to moisture when laid in the street. Merely increasing the thickness of concrete will not prevent cracking and failure. Concrete failure is primarily due to absorption of moisture from the earth which induces internal stresses in under surface of the pavement. The magnitude of the stresses set up depend on quantity of moisture present and capacity of the concrete to absorb the moisture. Mid-summer heat favors the absorption of moisture by the concrete.

Concrete has a small amount of elasticity. The co-efficient of elasticity is about 1,000 times the compressive strength. For a concrete of 3,000 lbs. compressive strength the co-efficient would be about 3,000,000, which in turn means that a load of 1 lb. per sq. in. in tension or compression would change the length about 1/3,000,000 of the loaded section. It will be seen from this that a sample in tension will usually fail when enlongated 1/10,000 of its length, while a concrete in compression may change 1/1,000 of its length.

Internal Stresses in Concrete

Engineers have been slow to recognize and provide for a measurable and possible control of the internal stresses set up in concrete from moisture and temperature differentials. Practical tests have disclosed that 1% moisture by weight, which is about 2¼% by volume will strain concrete to its yield point Concrete uniformly saturated with moisture and elongated therefrom, failure will occur from transverse cracks, if the tensile strength of the cross section of concrete is not great enough to move the mass.

The more common cause of failure in concrete pavements is from longitudinal cracks caused, almost without exception, from moisture absorbed by the lower surface of the concrete. This absorption causes an elongation of the lower surface of the pavement, which tends to cause it to curl up at the outer edges at the curb. This behavior throws a tension load on the upper surface of the concrete, and it cracks from the top down in a longitudinal direction, modified largely by the fortuitous character of the concrete.

Upon examination of a section of sidewalk on Grand River avenue west, a deflection of 7/8 in. was found in a sidewalk slab 60 in. wide. This slab is an arc of a circle, 120 ft. in diameter. This slab was laid in 1905, and is not cracked. Sidewalks crack, with but few exceptions, from moisture effect.

This condition will be found the rule and not the exception. When the bending moments exceed the amount of resistance failure occurs. It will be readily seen that in a street about 30 ft. wide, with a 6-in. pavement having 1:3:6 concrete and a capacity for about 6% absorption by weight, or about 13.5% by volume, longitudinal cracking is inevitable even with reinforcement at lower fibre.

The normal loading of a pavement is from the top, by putting the surface in compression and lower side in tension. Moisture reverses the loading by introducing the internal stresses which will cause cracking without running a single load over its surface.

An absorption test from slag G gave a unit expansion from moisture of .0005, which, considered for tension, is five times the elastic extension. A compression test gave 2,963 lbs.

An absorption test for lower side of slab A for a 10-day period gave a deflection of .061 in 60 in. This exceeds the normal elastic deflection of the slab. If the slab ends had been restrained, the slab would have broken from the top surface and near the middle. Water marks could be observed on A.

Contributing Causes of Pavement Failure

Aside from the effect of moisture in the earth below a pavement, is its behavior under various kinds of traffic. The complete failure of the pavement on Grand River avenue is an example of the failure not only of the foundation, but the inutility of sand under a block. Any form of shock imparted to a pavement is a serious and potential cause of failure. Tests made ten years ago disclosed that sand with 23% voids would hold a static load up to 26,684 lbs., distributed over 32 square inches. A 5-lb. weight dropped five times from a height of 5 ft. displaced the sand to the same extent as under the heavy load. Shock may be caused from defective tires or irregular pavement surface. No. pavement or foundation can last where shock is contained. A definite limit should be provided in pavement specifications for surface irregularities. A recording instrument can be readily devised to accomplish this.

The Tests

In December, 1921, samples of 6 and 8-in. slabs were prepared under Department of Public Works specifications for pavements. The mix was 1:3:6. The slabs were made by employees of the department. The cement was a standard portland. Sand had a void of 35.5% in bulk. When screened the voids ranged from 37.5% to 47%. It is evident from this value for voids in sand that a 1:3 proportion of cement and sand would not make a uniform concrete. This fact was clearly shown in the slab tests.

Five slabs, 6 by 12 by 60 in. were made, three of which were plain and two reinforced with two 5/8-in. deformed bars. Three slabs 8 by 12 by 60 in. were made, one of which was plain and two reinforced, one with two 5/8-in. bars and one with two 3/4-in bars.

The slabs were tested to destruction by placing them on supports 48 in. apart and loading midway with an Olsen testing machine.

6-in. slab A, plain concrete, broke at centre load of 3,140 lbs.
6-in. slab B, plain concrete, broke at centre load of 2,350 lbs.
6-in. slab C, reinforced concrete, broke at centre load of 8,760 lbs.
8-in. slab D, reinforced 3/4 rods, broke at centre load of 24,960 lbs.
8-in. slab E, reinforced 5/8 rods, broke at centre load of 8,020 lbs.
8-in. slab F, plain concrete, broke at centre load of 320 lbs.
6-in. slab G, plain concrete, broke at centre load of 1,960 lbs.
6-in. slab H, reinforced, is under absorption test.

These tests show a wide variation in strength and clearly point out the desirability of a close check up on character of concrete as made and used. This can only be done by taking samples from the job and testing regularly. This will insure better pavements.

Conclusions

1. An 8-in plain concrete pavement may be expected to be about 160% stronger than a 6-in. plain concrete pavement, with identical concrete.

2. These tests show that with the mixture used, an undesirable pavement would result. The sand indicates 1:2:4 mix. This concrete would take excessive moisture.

3. Concrete pavements are the most desirable from point of tractive effort. The ratio as determined being about 47 for concrete to 74 for asphalt.

4. More attention must be given to the construction of concrete pavements that will absorb the minimum of water.

5. With an added cost of 35 cents per yard a 6-in. reinforced concrete pavement can be constructed that will be over 300% stronger than a similar plain concrete pavement.

6. Concrete is more desirable for heavy traffic than any other type of pavement. The tractive resistance remains constant.

7. All concrete pavements should be reinforced. Slabs C and E are broken under heavy loads, but the steel holds the concrete so closely that fractures are not discernible.

8. Longevity of concrete in streets will increase with reduction of moisture content.

9. A standard for surface smoothness should be established for new work. Shock is destructive to vehicle and pavement.

10. The cost of an 8-in. pavement will be about 30% more than a 6-in. pavement, and its strength about 160% greater. A 6-in. pavement reinforced as indicated in this report will be about 300% stronger than the 6-in. plain concrete, and will cost 35 cents per yard more and be about the same cost as 8-in. plain concrete.—J. A. McCabe, research engineer, City of Detroit, in "Concrete."

How Kentucky Obtains Good Road Workmanship

By D. R. LAYMAN

In "The Constructor"

The Kentucky Association of Highway Contractors in February, 1922, recommended to the State Highway Department that every bidder be required to file with, or prior to, his bid a complete sworn statement of his finances, previous experience and equipment. This recommendation was made in the belief that such requirement would tend to elevate the standard of work for which the Department is striving. Prior to that time, the Highway Department provided in its notices that all contractors not then performing work under the supervision of the Department or whose financial standing, experience or equipment were not known to the Department, should submit with proposal a statement of equipment, banking references and references from those with whom they had theretofore done business. In reply to our request, the Department stated that it believed its present requirements were sufficient.

Recent developments, however, have indicated the necessity of applying to all bidders requirements for financial and experience statements. Confusion has been caused and perhaps some injustice done by failure of certain bidders to attach statements to their proposal when they felt that their ability and experience were so well known to the Department as to make the statement unnecessary. Some contracts have been awarded to the low bidder on the judgment of the Department that the successful bidder was competent to execute the work, but subsequent developments have not borne out the expectations of the State.

The Department, beginning August 15, 1922, now requires each bidder to attach to his proposal three questionnaires covering experience, finance and equipment. The forms of these questionnaires appear herewith.

The Kentucky Association feels a measure of gratification that experience of the last few months has justified the wisdom of its recommendation in this respect. It is also encouraging to know that our efforts have been beneficial to legitimate highway contractors in that experience and ability are now given consideration in the award of contracts.

Financial Questionnaire

To the State Highway Commission,
Frankfort, Kentucky.

Gentlemen:

As a part of my proposal on Federal Aid Project No. ...., Section ...., State Project No. .... Section ....(I or we) submit the following condensed financial statement:

Assets

Cash subject to check—
Deposited in banks named below
Name of Bank Location Amount
Total bank deposits........ $............
Amount of all other cash available .... $............
Total cash .... $.............
Cash value of equipment $............
Cash value notes receivable ....
Cash value stocks and bonds ....
Cash value accounts receivable ....
Cash value of all other personal property ....
Total value of personal property .... $.............
Cash value of all real estate, located in ....
.... (County)
.... (State) $.............
Total assets .... $.............

Liabilities

Amount of outstanding unsecured notes .... $............
Amount of outstanding mortgage or lien notes ....
Amount of outstanding accounts ....
Total liabilities .... $.............
Total net worth .... $.............

In addition to the above statement (I or we) also make answer to the following questions:

What banks or bankers do you give as references? ....
....

How much credit will these banks or bankers extend you on this contract? ....
....

Do you meet your obligations promptly and discount your bills? ....

....

Have you ever been insolvent or bankrupt? If so, when?...

....

Have you ever failed to complete a contract on account of a lack of finance ....

....

Will the above condensed financial statement favorably compare with the detail statement you will render a surety company when applying for bond? ....

....

....

Contractor.

* * *

Experience Questionnaire

To the State Highway Commission, Frankfort, Kentucky.

Gentlemen:

As a part of my proposal on Federal Aid Project No. .... Section .... State Project No. ...., Section ...., (I or we) submit the following answers to questions:

1. How many year's experience have you had in highway construction as general contractor or subcontractor?.....
   ....
2. On what types of construction have you been mostly engaged ....
   ....
3. Have you ever done any work for the U. S. Government? If so, where and to whom do you refer? ....
   ....
4. For what State Highway Department have you performed work, and to whom do you refer? ....
   ....
5. Under what county have you performed work, and to whom do you refer? ....
   ....
6. For what city have you performed work, and to whom do you refer? ....
   ....
7. For what corporation or individual have you performed work, naming the corporation or individual? ....
   ....
8. Do you complete your work on contract time, unforeseen contingencies allowed for? ....
   ....
9. What is the largest contract you have ever had, and where, giving in detail types of construction, etc.?......
   ....
10. Do you propose to sublet this project, or any parts thereof, if contract is awarded you, or exerute it yourself?
    ....
    What part or parts do you propose to sublet if contract is not executed by you? ....
    ....
11. Have you ever failed to complete any work awarded you? If so, where and why? ....
    ....
12. Have you a going organization now ready to place on this project? If not, how soon can you perfect an efficient organization ....
    ....

....

Contractor.

* * *

Equipment Questionnaire

State Highway Commission, Frankfort, Kentucky.

Gentlemen:

As a part of my proposal on Federal Aid Project No. .... Section .... State Project No. ......, Section ...., (I or we) submit the following list of equipment now available for work that may be awarded:

No.	Items	Type	Size or Capacity	Present Value

....

....

....

....

....

Contractor.

The Venus Everpointed

That the Venus Everpointed, the metal pencil manufactured by the American Lead Pencil Company has an unusually simplified mechanism, was strikingly illustrated by an experience recently related by a well known engineer. The engineer states that he inadvertently left his new gold Venus Everpointed within reach of his four year old son, who promptly made an investigation of what "made it go". When discovered, the youngster had the pencil "dissembled" in a most efficient manner, and the engineer fully made up his mind that the immediate future contained a repair bill to put the pencil back in working order. To his surprise, it was constructed with so few working parts that he assembled it in a moment, without the least trouble, and with no harm done. The "fool proof" propelling mechanism of Venus Everpointed consists of the following: the tube into which the head fits and into which the plunger also fits; and revolving on this tube another tube having a special slot machined in it which engages the shouldered part of the plunger. Another improvement with the Venus Everpointed is that the refill leads are simply and easily inserted from the front, a year's supply being contained in the tube with the pencil head.

Canada Spends $50,000,000 on Highways

Fifty million dollars will have been spent on improving Canada's highways, many of which are of the asphaltic or resilient types, when the five-year period terminates in the fall of 1923, according to reports received by A. W. Campbell, Dominion Commissioner of Highways. Of this total $20,000,000 will have been appropriated by the Dominion Government and the remainder by the different provinces. Of the Dominion sum there is yet $800,000 to be taken up by the provinces.

Agreements have already been entered into by the Province of Ontario calling for an expenditure of $12,500,000 by the end of 1923, of which sum, $5,000,000 is the Dominion share.

The New Brunswick Government now has all of its appropriation of $3,000,000 under agreement, the Dominion Government contributing $1,200,000. A total of 1,595 miles of highways are scheduled for improvement.

Alberta, the last province to take part in the Dominion highway scheme, has just filed for approval plans for road improvement under the Canada Highways Act. All of the provinces are now working under the general regulations provided by this act, and the work throughout the provinces is being carried out in accordance with uniform standard specifications.

Estimating the Cost of Highway Bridges

Useful suggestions on preparing estimates for the the construction of highway bridges were given by Walter S. Todd. Assistant Bridge Engineer of the Illinois Division of Highways, in a paper presented at the last annual short course in highway engineering at the University of Illinois. The paper follows:

A good estimate is one which approaches very closely to the actual cost of construction, with a fair profit to the contractor included. In order to secure estimates, actual cost records of similar work should be available to the estimator.

There are two factors which made it difficult to secure reliable estimates on highway bridges; first, the construction of bridges of the types now common, and by the method now prevalent is comparatively recent, so that cost records are not available which are applicable to present types and methods of construction. Second, the securing of actual costs while construction is in progress involves extra work upon the engineer in charge of the work, and consequently is generally slighted. The time and energy required to "boil down" cost records to a unit basis,, so that it may be used on similar work for estimating purposes, is very great. The results obtained, however, are worth the effort and form a basis for estimating.

Preliminary Estimate

There are two kinds of estimates—preliminary and final—and each has its particular field of usefulness. A preliminary estimate may be based upon approximate data, but with sufficient information at hand, it should not vary greatly from an estimate which is made after the detail plans are complete. A preliminary estimate may be based upon plans for structures of a similar nature which have already been prepared, or upon standard plans. Curves may be prepared which show the relation between size of structure and volume of material required, and the amount of material required for a given structure quickly obtained from them.

The preliminary estimate has three distinct uses. It may be used to determine the most economical span length to adopt for a multiple span structure. It may be used in reconnaissance for determining the most economical route to choose between two fixed objectives, i. e., the cost of earth work, pavement and bridges on one route may be compared with the same items on another possible route.

The preliminary estimate permits the determination of the approximate cost of structures without the aid of complete plans. An estimate of this kind is also essential to present a definite basis for a campaign to secure funds to finance construction, and is generally demanded before completed plans are available.

Final Estimate

The final estimate is made after surveys and plans are completed, and should represent the engineer's best judgment regarding a reasonable final cost of the structure to the public or owner. An estimate may be quite accurately made if it is subdivided into the various items of material, labor, transportation, etc., which are involved in the construction. As an example, the following items are covered in an estimate for a reinforced concrete bridge; and each item is given in terms of 1 cu. yd. of concrete in the finished structure; (1) cement equals the number of barrels per yard of concrete multiplied by the sum of the cost of cement f. o. b. nearest station, and the hauling cost from station to bridge site; (2) fine aggregate equals volume of sand per yard of concrete multiplied by the sum of the cost of sand f. o. b. nearest station and the hauling cost; (3) coarse aggregate equals volume of stone or gravel per yard of concrete multiplied by the sum of the cost of coarse aggregate f.o.b. station and the cost of hauling same; (4) form and falsework lumber; (5) labor required in placing forms and falsework; (6) labor required in mixing, conveying and spading concrete; (7) reinforcing steel delivered at the bridge site; (8) labor in bending and placing steel; (9) removal of existing bridge; (10) excavation cost per cubic yard of concrete; (11) incidentals such as name plate, expansion device or brick for hand hails, when used. The sum of these items may then be multiplied by the total yardage in the structure and a percentage added to same to cover liability insurance, profit, contingencies, superintendence and overhead.

It is generally best to add the cost of piling as a separate item, as the cost of this part of the work is not generally accurately known in advance. The contractor may be instructed to submit a unit bid and payment may be made upon the lineal feet actually driven.

It is a comparatively simple matter to determine the quantities of material requiring for a structure, but the cost of labor is best determined from previous work of a similar nature. These labor costs should preferably be in terms of man-hours, so that variations in labor rates may be easily applied. The bridge office of the Division of Highways of Illinois has kept records of labor costs for a large number of highway bridges of various types which have been built from standard plans.

In Table 1 all structures considered had reinforced concrete abutments with the exception of the structures listed in the last column.

In the estimate of the cost of structural steel superstructures, the principle of dividing the estimate into the various labor, material and transportation costs is advisable. The chief items involved, exclusive of floor, in the cost of a steel truss are as follows: mill or warehouse price of structural shapes; freight from mill or warehouse to fabricating shop; fabrication costs, including detail plans, reaming shop paint; freight from the fabricating shop to station nearest site; unloading and hauling to the proposed site; falsework; erecting; field rivetting; field painting; liability insurance; profit and contingencies.

Table 1—Cost Data for Reinforced Concrete Highway Bridges

Type of Structure .	R. C. box.	Slab bridge.	Thru girder bridge.	Deck girder bridge.	Plain concrete abutments
No. of bridges considered	83	93	48	3	5
Man-hours Per Cubic Yard of Concrete					
Building forms	4.24	4.41	4.71	7.04	2.69
Mixing and placing concrete	3.97	4.65	4.33	3.87	3.45
Bending and placing steel	0.68	0.75	1.51	1.24	...
Feet B. M. Per Cubic Yard of Concrete					
Form and falsework lumber..	**24.20**	**16.53**	**17.54**	**20.23**	**10.00**
Pounds Per Cubic Yard of Concrete					
Average amount reinforcing					
And substructure	**100**	**44**	**53**	**57**	....
steel in superstructure ..	100	198	230	255	...

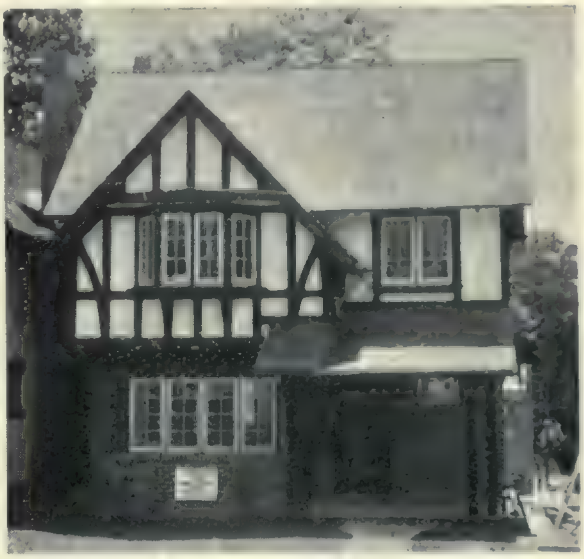
The Contract Record's

Weekly House Suggestion No. 38

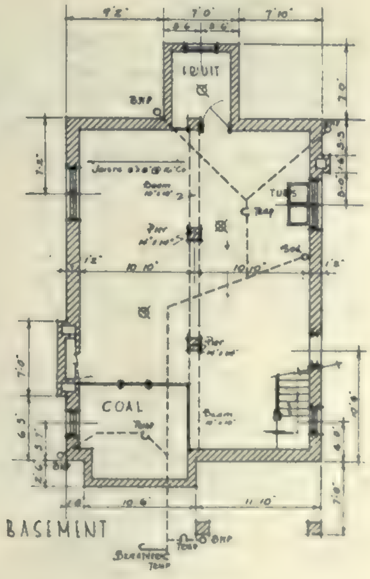
Another neat residence of the brick and stucco type is presented herewith. This house was built recently by Mr. H. Addison Johnson on Duart Park Road, Toronto, and is an excellent example of the well planned medium sized home. The exterior construction is red face brick to the second floor and stucco above, with attractive wood trim at the front, stained, brown, in keeping with the general tone of the exterior. The roof is of wood shingles.

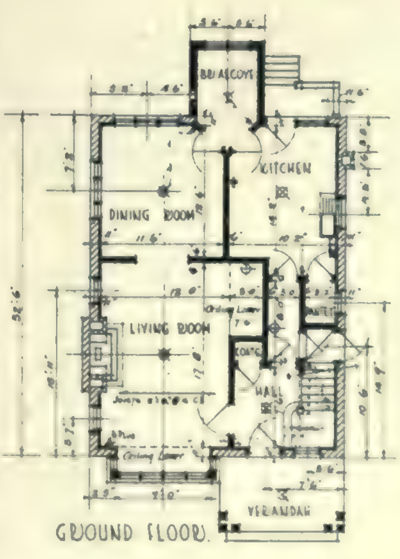
The front entrance from the veranda is on a square hall, with main staircase immediately to the right and entrance to the large living room on the left. The living room is equipped with a handsome fire-place in the left wall, as indicated on plan. The ceiling of the room is furred down over the buffet alcove in the right wall. The dining room is located at the rear of the living room and is a good sized, well lighted room, with entrance directly on the kitchen and on small breakfast nook at the rear. The latter room, as seen on plan, is conveniently located to both dining room and kitchen and is finished in white enamel. The kitchen has an entrance from a porch at the rear and may be also reached through the side entrance by way of the hall extension. This is an especially well planned layout for a ground floor. The floors throughout are of quarter cut oak and the trim is in gumwood with walnut finish.

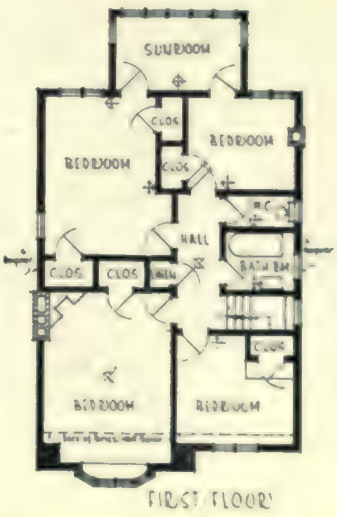
The second floor includes 4 good-sized bedrooms, sun room and bath room with separate toilet. The rooms are all conveniently located off the upper hall and are well provided with closet space. The sun room has entrances from both rear bedrooms. The four bedrooms are trimmed in pine, white enamelled and the flooring is of plain red oak. The bathroom and toilet are finished with tile wall and floors, trim being in white enamel.



The basement is divided into fruit cellar, coal bins, laundry and boiler room. The builder of this neat little home is Mr. H. Addison Johnson, 13 Silver Birch Ave., Toronto..







Mainly Constructional

East and West—From Coast to Coast

Cement Block & Brick Co., 105 Ritchie Ave., Toronto, have changed their name to the Excelsior Brick Co., and will carry on business at the same address.

The town of Hanover, Ont., will shortly vote on a by-law proposing the adoption of Ruhl Lake as the source of the town's water supply.

A fire which started in the plant of Joseph Gosselin, Ltd., general contractors, of Levis, P. Q., recently, destroyed the entire plant, a store and several residences. The damage is estimated at about $500,000.

The estimated total required for public works construction in Quebec city next year is $2,000,000, as arrived at by the city council recently. It is thought unlikely however that the Legislature will authorize the borrowing of so large a sum, so that it will be necessary to substantially reduce this figure.

The large contracting firm of Merlo, Merlo & Ray are expending $100,000 on improvements to their newly acquired river front property at Ford. The main item in this improvement scheme is the construction of a modern concrete dock, 227 ft. in length and 12 ft. wide, which when completed, will permit the docking of the largest lake freighters.

It is stated that the town of Tillsonburg, Ont., is at present negotiating with two large industries in connection with the establishment of large manufacturing plants in that town. One of the companies interested manufactures fire engines and tractors and our report states that the only condition the town has to fulfill in order to secure this industry is to guarantee the sale of $25,000 worth of the capital stock in the town.

At the meeting of the executive of the Canadian Good Roads Association held in Montreal recently, and attended by Hon. J. L. Perron, Quebec Minister of Roads; President, S.L. Squires, Toronto, chairman; Russell T. Kelly, Hamilton, and W. A. Findlay, Toronto, arrangements were completed for the holding of an interprovincial good roads conference in Montreal early this month, to which each of the nine provinces of Canada are invited to send delegates.

According to iron and steel statistics from Washington, Canada was the foremost buyer of American material, in July taking 48,010 tons out of a total of 159,338 tons exported. Canada's purchases included 8,630 tons of ingots, blooms, billets, sheet bars and skelp, 6,427 tons of iron and steel bars and rods other than wire, 3,808 tons of iron and steel plates, 5,780 tons of structural material, 3,526 tons of black steel sheets, 3,101 tons of galvanized sheets, 2,369 tons of steel rails, and 1,899 tons of hoops, bands and strips.

Mayor George C. Coppley, of Hamilton, is the newly elected president of the Ontario Associated Board of Trade and Chambers of Commerce, other officers elected at the recent annual gathering of this body in Owen Sound being:—Honorary presidents: R. Home Smith, Toronto; Wm. Taylor, Owen Sound; John Elliott, Belleville; Col. H. Brock, Toronto; first vice-president, M. P. Byrnes, Collingwood; second vice-president, J. G. Elliott, Kingston; third vice-president, K. J. Dunstan, Toronto; secretary-treasurer, F. G. Morley, Toronto.

The new $650,000 high school at Walkerville, Ont., is practically completed and will be officially opened soon. It is of plain oblong design, constructed of brick and tile, absolutely fireproof and three stories in height. Besides the many classrooms, there is an auditorium in the centre of the building, with a seating capacity of 800, a fine gymnasium, play rooms for boys and girls, dental inspection office, nurses office, a lunch counter and separate dining rooms for boys and girls, library, laboratory, teachers' quarters, commercial manual training quarters, and a large swimming tank with showers, individual lockers, etc.

About thirty members of the Engineers' Club, of Toronto, were present at the finals of their golf tournament, held recently on the links of the Mississauga Golf Club. Mr. J. R. W. Ambrose defeated Mr. J. C. Armer for the trophy presented by the past presidents of the club. Mr. W. P. Dobson won the consolation match and Mr. C. C. Mills made the highest score of the afternoon. Mr. Armer who "engineered" the tournament, presided at the dinner which followed and distributed the prizes.

The plans for the new city hall at Montreal have been approved as regards the general outline, with a few minor revisions being suggested by the commission of architects. Tenders have been called for the erection of the steelwork within the walls of the old building, which are going to be used in the new structure and it is estimated that the entire building and furnishings will cost about $1,500,000. The main feature of the new building will be a large reception or assembly hall, 80 ft. long, situated in the centre of the building, which will be surrounded by a gallery supported by marble pillars.

The following officers were elected recently at the annual meeting of the Royal Architectural Institute of Canada, in Winnipeg:—L. S. Gordon, Winnipeg, president; J. S. Archibald, Montreal, first vice-president; A. L. Mercer, Vancouver, second vice-president; Alcide Chausse, Montreal, secretary, and J. B. Hynes, Toronto, treasurer. The executive committee will be composed of Messrs. Gordon, Mercer, Chausse and Hynes, representing their respective provinces, and Prof. E. S. Burgess, Alberta, and F. P. Martin, Saskatchewan. It was decided that meetings of the executive will, in future, be held in Winnipeg, in view of the fact that Winnipeg is the most central point. This will only apply to meetings to be held between annual assemblies. Headquarters of the society will not be established at Winnipeg as reported recently, but will remain at Ottawa. The next annual assembly will be held in Montreal.

Personal

Hon. H. E. Armstrong, Minister of Public Works, Nova Scotia, is at present touring the Canadian West for the purpose of securing data on the various fair grounds of the larger cities, which information will be used by the authorities at Halifax in the preparation of plans for the reconstruction of that city's fair quarters.

Trade Incorporations

Riverdale Brick Company, Limited, with head office at Toronto, capital $40,000, to manufacture and deal in brick, terra cotta, tile, etc.

Lake Erie Brick & Tile Co., Ltd., with head office at Leamington, Ont., capital $100,000, to manufacture brick, tile and clay materials of every description.

A. Cope & Sons, Limited, with head office at Hamilton, capital $40,000, to carry on the business of general contractors.

Lowry Contractors, Ltd., with head office at St. Catharines, capital $40,000, to carry on the business of contractors and dealers in building supplies.

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U. S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 **Toronto, October, 11 1922** **No. 41**

Guessing at Costs

Do contractors bid intelligently and with full knowledge of the factors involved in the jobs on which they figure? This question has been asked time and time again with, generally speaking, an answer in the negative. That is to say, in most lists of estimates submitted on a proposed project, there is usually such a wide disparity in the tenders as to warrant the opinion that some of the bidders, at any rate, are estimating without an intelligent knowledge of what is required and involved in the construction of the proposed work. This is an old topic, as old as contracting itself, but it cannot be considered threadbare so long as it suggests a moral that has a sound application to present-day contracting. And it surely has, for in spite of all that has been said and written in the past, contractors are still operating largely in the dark as far as estimating is concerned. We all remember the cartoon that has been current for many years, in which the much-harrassed contractor, after receiving the contract at the lowest figure, wonders what he has left out. Certainly judging by the wide differences between low and high figures on most tenders, it is either a case of low man leaving something out or the high man adding something on. The latter, undoubtedly, represents the safer of the two evils in that it, at least, guarantees against loss and possible bankruptcy.

The prime function of an estmate is to obtain as close an approximation to the true cost of the job as possible without actually carrying it out. To make this estimate more than a mere guess requires an intelligent idea of what the project demands of the contractor, a thorough experience in construction and administrative methods and a sane application of cost data obtained from previous operations. If estimating is carried out on this basis, the result should then be a figure that will represent within a fair degree of accuracy the true cost of the job.

Unless it is assumed that all bidding is not carried out on this principle, there could not be the wide discrepancy that we sometimes observe in analyzing tenders. For instance, in the list of bids submitted on a small power development described recently in the "Contract Record," the highest tender was 264% of the lowest, or, in other words, a difference of 164%. Surely there must be something amiss when a 164% difference exists between the tenders of two contractors supposed to be bidding intelligently. But let us go further and analyze some of the unit prices. Concrete was quoted at from $10.00 to $16.00 per cubic yard, perhaps not an unseemly difference, but rock excavation prices varied from $3.15 to $30.00 per unit with excavation from 65 cents to $4.50 and fill from 30 cents to $4.00. Comment on these figures seems almost unnecessary, the disparity indicated showing the need for a revision in the bidding practices of many contractors.

As a contrast to the above we might point out that the tenders for the hydraulic and electric equipment for the same power house showed only a difference of 45% between the high and low tenders. It just indicates that equipment manufacturers have a better idea of costs than contractors and apply them more intelligently. Of course, there are greater hazards and more uncertainties on construction operations than in manufacturing which is all the more reason for care in compiling estimates; but, making all due allowances for these and for differences in contractors' organizations and equipment, there is no excuse for a 164% variation in bids.

Building Statistics Indicate Better Business

During September, construction contracts awarded in Canada, according to MacLean Building Reports, Limited, amounted to $29,313,500, compared with $25,187,500 in August. Residential building accounted for 32.5% of the September total and amounted to $9,534,100. Business building amounted to $6,275,600, or 21.4%; industrial building $5,170,200, or 17.6%, public works and utilities $8,333,600, or 28.5%. The value of contemplated new work reported during September was $39,076,800.

Revival in general business is reflected in the fact that manufacturers are extending old plants and building new ones. The September total of $5,170,200 compares most favorably with $886,400 in the corresponding period of 1921 and $2,342,500 in 1920. The total value of industrial buildings erected this year to date is 50% more than in 1921, and if the work now contemplated is proceeded with this fall, the year's total will easily double that of 1921.

With improved business conditions and stationary prices, the building industry throughout Canada is going to boom. The total of contemplated projects reported in September alone, bears out this fact. This total of practically forty million dollars is more than double last month's figure and exceeds by 33 1/3% the largest monthly total since such records have been kept.

No. 84

Canada's Engineers—Sir Henry Worth Thornton

Last Wednesday the Canadian government through the Prime Minister announced the appointment of Sir Henry Worth Thornton as managing head of the Canadian National Railway system. He will commence his duties within a month, taking complete charge of the railway in conjunction with a new board of directors. Sir Henry, although an American by birth, has been since 1914 general manager of the Great Eastern Railway of England and came into considerable prominence during the closing years of the war as the director of army transportation in France. That he is thoroughly versed in railway affairs is obvious from the following sketch of his career:

Sir Henry Worth Thornton was born at Logansport, Ind., U.S.A., in November, 1871, and graduated from the University of Pennsylvania (Department of Civil Engineering) with the degree of Bachelor of Science in 1894. He obtained employment with the Pennsylvania Railroad Company in December of the same year as draftsman in the chief engineer's office and held successively the positions of assistant engineer of construction on the Cleveland and Marietta Railway, topographer on various surveys, assistant of engineer corps, division engineer and division superintendent. In 1911 he was made general superintendent of the Long Island Railroad which had been acquired by the Pennslyvania Railroad Company. In this capacity he had much to do with the opening of the Pennsylvania Railroad terminal in New York and the organization of the electrical train service on the Long Island Railroad.

While employed as assistant in the engineer corps of the Pennsylvania Railroad, Sir Henry was selected by the then general manager, L. F. Loree, to develop a students' course in transportation, and, under Mr. Loree's instructions, worked in every department of the railway for a sufficient time to become familiar with its operation.

In April 1914, he was called to England as general manager of the Great Eastern Railway. This Railway enjoys the largest passenger traffic of any railway in the world, it is said, there passing through its principal London terminal, Liverpool Street station, 76,000,000 passengers per annum, which is about one and a half times the number of passengers using the principal New York stations.

The Great Eastern Railway also operates an important line of steamships between Harwich, the Hook of Holland, Rotterdam and Antwerp. It also operates extensive hotels, dining rooms and dining car service.

When war broke out in 1914, the Great Eastern Railway, serving the east coast, became one of the most important military lines of communication. Sir Henry Thornton was made a member of the executive committee of general managers which, under the direction of the government, controlled and worked all the English railways.

In 1916 he became deputy director of inland water transportation with the rank of colonel in the Royal Engineers. This department handled all the inland navigation in northern France, Egypt and Mesopotamia.

Early in 1917, Sir Henry was sent to Paris as assistant-director general of movements of the railways and in that capacity represented the director-general and the army council in negotiations with the French, Italian and American Governments, relating to transportation. In December, 1917, Sir Henry was made deputy director general of the movements of railways, with the rank of brigadier-general, and in 1918 was made inspector-general of transportation with the rank of major-general. In the latter capacity he had charge of army transportation on the continent.

Sir Henry was naturalized as a British subject in March, 1919. In May, 1919, he was gazetted a Knight Commander of the order of the British Empire. He is also a commander of the Legion of Honor of France, an officer of the Order of Leopold of the Belgians and a holder of the distinguished service medal conferred by the American Government.

Sir Henry Worth Thornton, K.B.E.

In 1920, Sir Henry was asked by the British Government to serve upon the commission to investgate the operations and financial conditions of the Metropolitan Water Board, this being the authority which controls the entire water supply of London. He has also served twice as a member of the National Wages Board in two arbitrations between the English railway companies and their men. He has enjoyed relations of peculiar friendliness with labor leaders in England, it is said, and has had notable success in dealing with labor on his own railroad, the Great Eastern.

The new president and general manager of the system is a member of the Institute of Civil Engineers, the Institute of Transportation, the American Society of Mechanical Engineers and various other scientific bodies.

Architects' Assembly in Winnipeg

The Royal Architectural Institute of Canada Combine Business and Pleasure at Their Fifteenth Annual Meeting—Many Papers of Interest to the Profession

On Monday the 25th of September, the Royal Architectural Institute of Canada started its 15th general annual assembly at the Fort Garry Hotel, Winnipeg, between 40 and 50 delegates being present. The morning session was taken up with registration of members of the Institute, and a meeting of the 1921-1922 council.

After luncheon W. J. Smart, president of the Manitoba Association of Architects, suggested that the federal and provincial governments should consult the Institute, and ascertain its views when contemplating the construction of large public buildings. He pointed out that the advice of the Institute and any suggestions it might make would undoubtedly be of great assistance to the governments when they decided upon large expenditures for public buildings and he believed that a great deal of money would be saved to the taxpayers. He also advocated greater co-operation between architects and engineers and expressed the belief that closer relationship between the architects and their employers would be most beneficial to both the profession and those who required the services of the architects.

In the absence of Premier John Bracken, who was unable to attend, Hon. F. M. Black, provincial treasurer, welcomed the delegates at the luncheon on behalf of the province. He was followed by Mayor Fowler, who extended the welcome for the city.

During the afternoon session after the various reports had been brought in, some very interesting papers were read, the first one being on "Research Work as Available for and Applicable to the Architectural Profession" by Frank G. Martin, president of the Saskatchewan Association of Architects. This paper is reprinted elsewhere. In a paper on "The Standardization of Building By-laws, Structural Methods and Materials, Architects' Fees, and Practice, etc.," Professor Cecil S. Burgess, president of the Alberta Association of Architects, stated that prizes were being given all over Canada for the best gardens in various cities; why not therefore offer prizes for the best architectural work? He also dealt with the necessity of training the student to a high standard of efficiency. In the discussion which followed, some speakers, while admitting it to be difficult to standardize the by-laws, thought that there should be a standardization of materials used by architects. This, it was claimed, would give prestige to the profession. Others advocated a bureau of standards for Canada, doing away with the necessity of taking the standards from Chicago, as is done at present.

Should Architects Seek Publicity

Following a general discussion on Professor Burgess' paper, a paper on "Co-operation with Other Organizations and in Activities in Which Others are Jointly Interested with Us" was presented by Mr. Andrew L. Mercer, president of the Architectural Institute of British Columbia. A considerable portion of Mr. Mercer's paper dealt with publicity. He stated the Architectural Institute of British Columbia had a display at the Vancouver building show, at which they distributed 2,500 well prepared booklets, which were given only to people who seemed to be interested in building. In addition a definite advertising campaign was put on in the local newspapers. Mr. Mercer claimed that this publicity campaign showed very good results. Considerable discussion followed this paper as to whether the Institute should seek publicity, the general feeling being that it should.

Mr. J. P. Hynes, president of the Ontario Association of Architects, who was on the programme for two papers, combined them in one, his subjects being "Publicity and Methods of Applying It to Our Profession," and "The Establishment of an Institute Journal." Mr. Hynes said that if architects advertise, it must be of the highest quality only. He also felt that every architect should have a standard pamphlet to hand to clients; also that the Institute was large enough to have a journal of its own.

L. H. Jordan, the new president of the Royal Architectural Institute of Canada

Mr. David R. Brown, representing the Province of Quebec Association of Architects spoke on "Defences Necessary to Maintain the Standing of the Profession," stating that he considered young men training for the architectural profession get a thorough schooling in Canada. Another point brought out by Mr. Brown that led to considerable discussion was, "Would it be right to ask for legislation to ensure the employment of Canadian labor only in Canada." In the discussion following this paper Mr. Cobb stated that Canadians cannot compete with the other side, unless given the opportunity. Mr. Mercer said that whenever there is a building boom in Vancouver, the American architects come up from Seattle, Spokane, San Francisco and other American cities, and if they can get one or two commissions, will open an office and remain while conditions are good. As soon as business is quiet, they go back to the states." He knew of one American architect who has taken three quarters of a million dollars out of the province of British Columbia. "We talk of the Hindu, Jap and Chinaman," he said, "but they are no worse than the American architect who goes to British Columbia to grab off all the work he can. You never hear of the Canadian architect going over to the states to grab off work."

Mr. Brown felt that in the meantime we should welcome the foreign architect, but the time will come when there will be no room for him in this country.

A paper on "Education as Related to the Advancement of the Profession" was then read by Professor Arthur A. Stoughton, of the Manitoba Association. This paper appears in this issue.

The evening was brought to a close with dinner at the Manitoba Club, with Mr. David R. Brown presiding. Professor W. T. Allison, of the University of Manitoba, gave an address. This was followed by a theatre party at the Orpheum Theatre, and the day was brought to a close with an after theatre supper and entertainment at the Royal Alexandra Hotel.

Tuesday morning was spent in general discussions and in winding up the business of the meeting. At noon the delegates left the Fort Garry Hotel for a motor trip to Lower Fort Garry, which is situated about 15 miles from Winnipeg, where luncheon was served in the clhb house of the Motor Country Club. After luncheon the motor tour was resumed to enable the visiting delegates to see points of interest in and around Winnipeg. On the return to the Fort Garry Hotel a meeting of the council was held for the purpose of electing new officers for the coming year.

L. H. Jordan of Winnipeg was elected president; J. S. Archibald, Montreal, first vice-president; A. L. Mercer, Vancouver, second vice-president; Alcide Chausse, Montreal, honorary secretary, and J. P. Hynes, Toronto, honorary treasurer. An executive consisting of one representative from each province was selected as follows:—L. H. Jordan, Manitoba; A. L. Mercer, British Columbia; J. P. Hynes, Ontario; Prof. E. S. Burgess, Alberta; F. P. Martin, Saskatchewan; Alcide Chausse, Quebec.

The council consists of Prof. E. S. Burgess, Edmonton; R. P. Blakey, Saskatoon; J. H. G. Russell, Winnipeg; J. N. Semmens, Winnipeg; C. S. Cobb, Toronto; S. I. J. Frye, Hamilton; H. E. Moore, Toronto; G. M. West, Toronto; D. R. Brown, Montreal; J. P. Ouellett, Quebec; Prof. Ramsey Traquir, Montreal; U. Vallance, Montreal; M. W. Sharon, Regina; D. Webster, Saskatoon; F. P. Martin, Saskatoon; S. M. Eveleigh, Vancouver; and two others to be elected from British Columbia.

It was decided to send congratulations to the Hon. Athanase David, Provincial Secretary of Quebec, for his efforts in the establishment of scholarships for students studying art. It was suggested that other provinces should adopt a similar policy. The convention closed with an informal dinner and smoker.

On the third and last day Wednesday, the delegates were guests of the Manitoba Association, when the time was happily spent playing golf.

Relation of Education to the Advancement of the Profession

By Prof. ARTHUR A. STOUGHTON
University of Manitoba

To those of us whose main work consists in planning architectural courses and exerting ourselves to carry students along so that at the end of the period of education they will have received the utmost we can give of preparation for their life work, it sometimes seems as if we were somewhat lacking in cooperation between the training agency and the body of trained men.

Let us consider for a moment what the business of the student is and then we shall see how he is related to the practitioner and what interaction is possible between the two classes. The ideal end of architectural education is to provide the knowledge of the science on which construction is based and of the fabric of forms in which architecture has embodied itself; to give the learner a working knowledge of constructive systems and principles of art; to make him sense by long practice the subtle process of assembling materials in a building, at once, noble and fine and expressive of its use and time; in short, to equip a man as a finished draftsman, designer, constructor, specification writer and superintendent, business man, man of culture.

To those who realize the volume of knowledge this represents and the long continued drill in the application of it all to qualify a man to design and execute acceptably even the common structure, it will need no further proof of the colossal task of the university architectural course.

It is almost needless to say that the only reasonable aim of the university under the circumstances is not to make a fully equipped architect but to initiate the neophyte into the mysteries, to start him on his way, to disclose the achievements of his glorious predecessors, and to help him to take the first steps. Imbued with the spirit of study and given the driving force of a great ambition to create as others have created, to embody his own visions and express himself and his times in terms of architectural form, he may continue to develop toward a control of the resources at his hand.

The Training Offered by the School

What then is a school to attempt to compass in a four or five years course? There should be a grounding in literature, history, language, mathematics and science for general as well as technical purposes since it is remarkable that scarcely any branch comes amiss to the architect. Training in architecture is the liberal education par excellence. On the foundation of exact science must be built up all those studies that fit the practitioner to use materials and build safely, thus relating him to the engineer. While he is learning how to draw in various media and to enable him to present his conceptions in adequate form he is furnishing his mind with material from the past and schooling himself by the study of the theory of architecture and principles of art and composition to himself design. At the same time he should be training his taste and developing his critical faculty and forming his style by keen analysis of all worthy architectural examples available that in the synthesis of design he may be able to bring out of his treasures, things new and old, creating essentially new and living compositions instinct with feeling and personality.

As adjuncts and aids in such a course there should be as large a collection as possible of books, slides, diagrams, models, casts, samples and catalogues. There should be contact with materials and processes and building operations by laboratory work, by visits to buildings and by work at trades, as well as by collections in industrial museums. The student should use the summer holidays in getting experience in offices or on buildings in course of construction, and in drawing and sketching and research. He should get inspiration from active members of the profession by visits and talks by architects and constructors, as well as in the person of his own instructors. There is no place in any ranks of teachers for the dry-as-dust expounder of rules, but above all in architecture and other creative and originating professions, the wings of the mind must be free to soar. The student must experience joy and exhilaration in his effort and his director must have enthusiasm as well as professional insight. He must communicate a personal inspiration to his followers to exercise their imaginations. For this reason he may well be a practising or at least a practical architect. Principles must be embodied in modern instances, research must have its counterpart in origination. ideas must flow at the suggestion of a program; the student's pencil must move freely at the behest of the imaginary client

Not that imagination must be unrestrained. Design must go hand in hand with construction. The architect must at all times design with the ever-present fear of structure and material before his eyes, and the student also must be drilled in this habit, but it is easy at any moment to pull the tethered bird to earth, the great need of the student is that he should see all design in a large and free way, unhampered for the time being by cost, by detailed construction, by tradition, by what his fellows are doing or what he thinks is in his teacher's mind. Then only will the student attain true freedom and gathering up all the material of his course under the guiding principles he has been taught, he will make the best use of his training as the first steps in the evolution of an architect.

The Relation of the School to the Profession

I have spoken at too great length of education as affecting the student. But the study of architecture or any other profession is not mainly cultural but preparatory to a career. The student learns in order that he may act. The school provides the ways by which at the moment of graduation he is launched into the basin of draftmanship, from which presently he will sail out into the sea of practice. The man who was a student is now an architect, but being the selfsame person he cannot deny his vital relation to the school with its personnel and its teaching and its atmosphere which has trained him, nor can he honorably turn his back on it as soon as he has left its doors. The strength of the attachment of the alumnus to his alma mater in all schools and in all ages points to the fact that there has been established something like the family relation, vital, intense and continuing. This relation is not merely sentimental, nor is it merely financial in view of the fact that the school has contributed several times the amount of his fees to the student's course. The graduate will feel, if he senses the true bearing of his position, that there is a solidarity between the school and the profession and himself. He owes allengiance to both as he belongs to both. To the profession as an association he is bound to act in personal and ethical harmony, endeavoring by the manner of conducting his practice to raise its standards and increase its prestige. To the school as the agency for training him and those who are to follow him into the ranks of the profession, he is truly indebted—first, for his own equipment for making his way; second, for the popular recognition of the profession which a school fosters in a community and, lastly, for the increasing honor with which an architect is viewed as more and more well-trained men begin to practice. The school therefore trains men to earn a living as architects but its larger —its university or universal—mission is to develop men of culture, gentlemen of the world, artists, leaders in a noble calling, upbuilders of world beauty.

School's Efforts Should Continue

It should, however, continue its ministrations beyond the moment of graduation, and they should in nowise be limited to its own alumni. It should provide a library and collections of illustrative material of architecture and all allied arts, available to everyone, supplementing lesser public or private collections, where professionals or amateurs may browse or find illustration of special points or conduct any study or research. By way of parenthesis, I may say that I am at a loss to understand how anyone engaged in such a fascinating art as creating beautiful architectural forms or developing interesting plans can deny himself the pleasure of frequent study of such illustrations as a school library affords, or that a person who has been in familiar contact with all this wealth of material for the period of a college course can be satisfied with his own little five-foot book shelf. The rooms of the school should be available for meetings of people interested in art. They might well be the regular meeting place of the architectural association. By this means the architects would learn their way to the department of architecture and would see exhibitions of its work and thus become more familiar with what it is accomplishing. This very desirable result depends, however, almost wholly upon the attitude toward the school of the individual architects, and here lies the main bar to the rapprochement of school and profession. The school may be as attractive and hospitable as possible and it may offer the freest use of valuable collections and it may seek the betterment of its course by the co-operation of the profession but if the other partner in this co-operation does not act, school and profession fail of the mutual benefit possible. A formal report of the progress and state of the school and its plans for the future should be made from time to time to the association but this is not enough. These matters should be discussed at every opportunity, formally and informally so that the practicing architects may know what the instructors are thinking and doing, how the university is sustaining the school, what the quality of students and work is and what improvements may be made.

A Vital Part of the Profession

The architectural school should be considered as a vital part of the profession and therefore essential to its future well being. In training the architects of the future it is making its great contribution to the advancement of the profession. In most cases it is a creature of the local association as it is in this city and therefore worthy of personal inspection and care. More and more is the regular university architectural degree course coming to be recognized as the best and well-nigh indispensable entry to the profession, and its curriculum and methods and its results should therefore come under the supervision and criticism of the practicing members of the profession. Sometimes this is brought about by a visiting board of architects, sometimes by a jury of architects to make awards in school competitions, sometimes by local architects giving talks or even courses of lectures to the students, sometimes by gifts of prizes or scholarships or additions to equipment on the part of architects or the architectural association, sometimes by the instructors giving talks to the architects or to the public or by writings in the public press. All these methods have advantages. The broad purpose is to relate profession and student body as closely as possible for the betterment of both and to bring the school to its highest efficiency that its graduates may become architects of the highest type. Thus we complete the cycle and find that the influence of architectural education on the advancement of the profession is purely a function of the advancement of that education, brought about largely by the efforts of the profession.

Research Work Applicable to the Architectural Profession

By **FRANK P. MARTIN**

In this country—the West particularly—it has more or less, been a matter of opinion, which actually is the best kind of construction to meet the requirements of such rigorous climatic conditions. In view of this, the Saskatchewan Association of Architects felt that something could be done to determine the relative values of different types of wall construction from a heat insulation point of view. We therefore approached the provincial government, asking them to have the university undertake some investigations along these lines. We were successful and up to the present time $7,000 has been spent upon the work.

You will know of some of the methods used in making similar tests. We thought that something more practical should be attempted, it was therefore decided that actual houses should be built. Work was started in 1920 when 6 houses were erected. These measure 6 ft. square by 6 ft. high inside dimensions. Since then 3 additional houses have been built. These comprise brick, brick and tile, concrete and various types of frame construction.

In order that accurate tests could be made, a Leeds and Northrup recording thermometer was installed, which gives a reading of one thermometer every 1½ minutes.

The first year was really spent in standardizing the equipment and getting corrections for the meters and other electrical equipment. The heating is accomplished by electric heaters made of fine resistance wire.

Last winter, readings were taken from the 1st of November up till the 1st of April. Complete records were kept with regard to outside temperatures, wind velocity and direction, sunshine and also the temperature inside each house. The records have not been fully plotted, nor has all the data obtained been tabulated.

Some Preliminary Results

Next winter some changes will be made in the houses and all data checked. The university will then be in a position to give the architectural profession data that will be of real service in wall insulation. I might say that the result of some of the tests was surprising. It was found that the heat transmission through a 13 in. wall of 4 in. brick, 8 in. hollow tile and plastered inside, was over 50% greater than through the wall of ordinary frame construction. Also the heat loss through ½ in. fibre board was considerably more than through gypsum fibre board. Another test of a concrete wall painted outside with cementrix reduced the heat loss by about 15%. In a 12 in. solid brick wall strapped, lathed and plastered inside, the heat loss was reduced by 12% after the walls had been papered with ordinary wall paper. Taking the ordinary frame construction, the heat loss was less by 26% after the space between the studs was filled with planer shavings. In a test of air space within walls, live and dead air space, a difference of 75% was found in favor of the latter.

It is of some satisfaction to know that in the near future, our knowledge in this matter will be very definite. Should the occasion arise, any of you will find that the university authorities are very willing to give what information they can and co-operate with you in any way.

The University of Toronto has been conducting experimental work in heat transfer tests of building materials since 1912. The method adopted was different from that of ours. A well insulated box, of wood, cork, paper, asphalt paint, etc., was made. In the centre of this was built the walls to be tested. This divided the box into two compartments, one to be used as the heating chamber and the other the cold room, the temperature being reduced by a refrigerating plant installed in an adjoining room. Professor Arkley has published a very explanatory report with a complete log of the tests made, also the conclusions arrived at. A comparison of the results of the tests made by the two universities, in the main, show very little difference.

Concrete in Alkali Soils

Of serious import to the profession is the deterioration of concrete in alkali soils. Research work in this regard has very timely been taken up by the Engineering Institute of Canada. Last year a committee was organized, including engineers and chemists of the three prairie provinces, men who had been engaged on this problem for years. The line of endeavour will cover field investigation and chemical research. What is hoped will be accomplished is that some means will be discovered whereby portland cement concrete as now constituted can be made immune to this disintregating action.

The field work consist of placing in the soil in several localities different types of concrete blocks made with various cements, aggregates, etc., some being treated with the different commercial waterproofing compounds. Sufficient time, of course, has not yet elapsed to permit of conclusions being drawn. The chemical research work is being carried out by a group of chemists who are devoting their full time to the investigation. Saskatoon as the central point and because it had civil engineering equipment and chemical laboratories was chosen as the headquarters, the work being conducted by the university.

Other Investigations Relating to Concrete

Investigations now under way in the engineering laboratory of the University of Saskatchewan are as follows:—

To determine the value of concretes prepared with pit run aggregates, as compared with the use of graded aggregates.

Permeability and compressive strength of concrete. A new type of apparatus is used to measure permeability or watertightness under pressure. In connection with the above, the various types of integral waterproofing compounds are being included.

Papers describing these tests in detail, and furnishing conclusions which will be of practical use will be published within the next few months.

An interesting case came under my personal observation recently. In one of the largest buildings in Saskatoon, the concrete basement walls show signs of being affected by alkali water. On the inside of the wall considerable incrustation has formed. It was decided to excavate outside to a depth of 10 ft. down to the footings. Two feet below the grade the concrete was slightly affected and became worse further down to within 1 ft. of the top of the footings, disintegration had taken place to a depth of 4 in., there it immediately stopped.

It was found that a 2 x 12 spruce plank, waterlogged but in a perfect state of preservation had been left in. Behind that the concrete was as solid as a rock. An examination of the excavation disclosed the ground water table about 3 ft. below the surface, of considerable volume and apparently rich in sulphates. As the building is 11 years old I have concluded that wooden cribbing with waterproofing joints, provides an excellent protection against the effect of alkali, for a considerable period.

The Saskatchewan government has established at the university a research department in clay products. Part of the time of Prof. Worcester, the ceramic engineer in charge, is spent in assisting the different brick yards in improving their products. In his prospecting work in the province he has discovered glass sands, coal, also clay equal to the best English china clay. At the university he has manufactured pottery, salt glazed tiles in various colors, also china ware of a very high grade as well as decorative tiling.

It is only by untiring research that one is able to give expression to real art and truly excel in design. Several American universities realize that fact fully and the University of Illinois, for example, has established a research department which they call "The Engineering Experiment Station," in which is included research. They have published a series of bulletins, one "The Volute in Architecture and Architectural Decoration," this is particularly interesting; another, "A Study Roof Trusses," also "Architectural Acoustics" and several engineering bulletins such as, "Tests of the Flat Floor Slab," "Beams, Etc.," Tests of the Brick Column," "Terra Cotta Column and Concrete," "An Investigation of the Built-Up Column Under Load," and numerous others. These bulletins can be purchased at very small cost.

Regarding research work being carried on, the opportunities never were greater than at the present time. It is possible to secure information of all that is taking place. The chief difficulty is to sift out what is of value to us in our practice.

I am thoroughly in accord with the appointment of a committee by this Institute, to inquire into and recommend to the council the means whereby a department could be established to accumulate and distribute reports of results of research work applicable to and of particular use to members of our profession.

Annual Convention A.C.B.C.I.
Feb. 6-9, Quebec

The Executive Committee of the Association of Canadian Building and Construction Industries held an important meeting last week with the Ethics Committee of the Associated General Contractors of America.

This meeting was arranged at the request of Mr. J. B. Carswell, Canadian president, as the result of certain difficulties that had been experienced. In certain cases United States contracting firms who had secured contracts in Canadian cities had disturbed wage rates, in spite of local agreements. It was therefore suggested to the A.G.C. that a joint meeting should be held to discuss this important situation.

The committees met on Wednesday, October 4, at lunch at the D.A.C., and had a very friendly and frank discussion of the mutual relationships and what both might do to avoid similar occurrences when United States contractors come to Canada or Canadian contractors go to the United States. It was finally decided that, instead of working out a long Code of Ethics, they simply recommend to the members of both organizations to remember the "Golden Rule." When a dispute arises it is to be submitted to a small committee of four,—two Detroit men and two Windsor men.

A regular executive meeting of the A.C.B.C.I. was held in Windsor during the same week and the date of the annual convention was decided upon. This will be February 6 to 9, and the place will be the Chateau Frontenac, Quebec.

Construction Developments During the Month of September

Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded and Contemplated

Construction Contracts Awarded in Eastern Canada, September, 1922

	Ontario		Quebec		New Brunswick		Nova Scotia		Eastern Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	4	$ 145,000	3	$ 395,000	....	....	....	....	7	$ 540,000
Churches	6	252,000	6	345,800	....	....	....	....	13	604,800
Factories	13	1,482,000	7	171,200	1	$ 300,000	....	....	21	1,953,200
Public Garages	12	158,300	20	100,500	....	....	3	$ 33,500	36	293,800
Hospitals	....	....	1	20,000	....	....	....	....	1	20,000
Hotels and Clubs	6	112,000	1	8,000	....	....	....	....	7	120,000
Office Buildings	11	247,000	1	11,000	....	....	3	170,000	15	428,000
Public Buildings	6	100,000	4	221,500	2	44,700	....	....	12	366,200
Residences	980	4,660,100	398	2,488,200	37	102,700	31	140,000	1450	7,405,000
Schools	17	1,229,800	8	652,000	2	100,000	5	127,200	32	2,109,000
Stores	25	353,000	9	166,000	2	12,500	3	25,000	39	556,500
Theatres	1	25,000	....	....	....	....	....	....	1	25,000
Warehouses	9	105,000	5	78,000	1	15,000	2	16,000	18	234,000
Total Buildings	1090	$8,869,200	463	$4,657,200	45	$ 574,900	47	$ 511,700	1652	$14,655,500
Bridges	10	$ 188,200	6	$ 55,600	7	$ 44,600	....	....	23	$ 288,400
Dams and Wharves	1	10,000	7	1,110,300	....	....	1	$ 4,400	9	1,124,700
Sewers & Watermains	16	229,200	1	165,000	....	....	....	....	17	394,200
Roads and Streets	17	408,100	16	600,600	....	....	....	....	33	1,008,700
General Engineering	20	4,279,300	5	650,000	3	30,000	3	25,900	31	4,985,200
Grand Total	1154	$13,984,000	498	$7,238,700	55	$ 649,500	51	$ 542,000	1765	$22,456,700

Construction Contracts Awarded in Western Canada, September, 1922

	British Columbia		Alberta		Saskatchewan		Manitoba		Western Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	2	$ 10,500	....	....	....	....	....	....	[illegible]	$ 10,500
Churches	2	6,700	....	....	....	....	3	$ 64,000	5	70,700
Factories	3	3,011,000	1	$ 200,000	1	6,000	....	....	5	3,217,000
Public Garages	7	43,600	2	2,500	....	....	[illegible]	133,200	14	179,300
Hospitals	....	....	....	....	1	54,800	2	22,500	[illegible]	77,300
Hotels and Clubs	1	7,000	....	....	....	....	1	10,000	[illegible]	17,000
Office Buildings	2	55,200	....	....	1	13,600	1	4,000	4	72,800
Public Buildings	3	14,000	5	63,300	....	....	1	8,000	9	85,300
Residences	181	639,800	62	200,600	63	240,500	127	497,700	433	1,578,600
Schools	10	151,500	6	24,400	5	28,800	2	62,700	23	267,400
Stores	23	345,300	7	41,500	3	11,400	11	109,300	44	507,500
Warehouses	8	147,000	3	68,000	3	21,000	1	5,000	15	241,000
Total Buildings	242	$4,431,600	86	$ 600,300	77	$ 376,100	154	$ 916,400	559	$6,324,400
Bridges	1	$ 35,000	....	....	....	....	....	....	1	$ 35,000
Dams and Wharves	1	100,000	....	....	....	....	....	....	1	100,000
Sewers & Watermains	1	26,000	....	....	1	$ 1,200	2	$ 28,000	4	55,200
Roads and Streets	2	33,300	....	....	1	63,000	2	12,400	5	108,700
General Engineering	1	193,500	....	....	1	40,000	....	....	2	233,500
Grand Total	248	$4,819,400	86	$ 600,300	80	$ 480,300	158	$ 956,800	572	$6,856,800

Contemplated New Construction Work in Canada, September, 1922

	Ontario		Quebec		Maritime		Western		Dominion	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	3	$ 170,000	3	$ 310,000	....	....	....	....	6	$ 480,000
Churches	4	170,000	1	100,000	1	$ 10,000	1	$ 10,000	7	290,000
Factories	12	6,562,000	4	10,165,000	1	10,000	6	2,685,000	23	19,422,000
Public Garages	5	313,000	2	16,000	1	10,000	....	....	8	339,000
Hospitals	4	47,000	....	....	....	....	4	95,000	8	142,000
Hotels and Clubs	3	32,000	2	30,000	1	40,000	5	33,000	11	135,000
Office Buildings	5	175,000	3	100,000	....	....	....	....	8	275,000
Public Buildings	3	29,500	....	....	2	42,000	6	132,000	11	203,500
Residences	68	475,500	[illegible]	568,000	16	140,900	42	170,200	211	1,354,600
Schools	13	720,000	8	697,000	2	85,000	29	162,800	52	1,664,800
Stores	24	244,000	1	3,000	1	3,500	19	418,000	45	668,500
Warehouses	1	25,000	....	....	....	....	5	74,000	6	99,000
Total Buildings	145	$8,963,000	109	$11,989,000	25	$ 341,400	117	$3,780,000	396	$25,073,400
Bridges	6	$ 54.000	9	$10,126,500	4	$ 21,800	7	$ 13,800	26	$10,216,100
Dams and Wharves	4	80,000	3	880,000	2	30,000	3	22,000	12	1,012,000
Sewers & Watermains	58	570,900	13	219,500	....	....	6	125,000	77	915,400
Roads and Streets	15	463,700	13	407,500	....	....	10	173,700	38	1,044,900
General Engineering	6	270,000	1	35,000	....	....	5	510,000	12	815,000
Grand Total	234	$10,401,600	148	$23,657,500	31	$ 393,200	148	$4,624,500	561	$39,076,800

How Pneumatic Tools Reduce Labor

The Labor and Cost Items in Laying a Six-Mile Gas Main Are Lowered by an Extensive Application of Pneumatic Tools, Operated From Portable Air Compressors

The extension of a gas pipe-line in the suburbs of New York City, involving the laying of approximately six and one-half miles of new pipe, has demonstrated numerous ways in which pneumatic tools can be utilized in quickening the work and in reducing the labor item.

The new pipe-line, of 20-inch diameter, is being laid at a depth of approximately three feet from surface and makes necessary the excavation of a trench four feet wide and five feet deep through ground of varying character. Almost every kind of ground is found along the line in the trench work—such as clay, solid rock, and sand, as well as clay with many large boulders interspersed. Of the total distance, 37 per cent. was figured as rock, with mostly clay and boulders for the remainder.

Speedy Work

The plans for the work stipulated a time limit of five months for the completion of the project. This meant that the following working schedule had to be maintained: 275 feet of trench excavated daily; one 12-foot pipe length placed every fifteen minutes; and one pipe joint calked for every corresponding time interval. With the pipe laid and calked, the trench had then to be filled and tamped at a similar rate so that the completed work could move forward an average of at least 275 feet each eight-hour day.

As the pipe-line route lay along many busy streets and thoroughfares, it was necessary to avoid tying up traffic as much as possible and to open up the trench, put down the pipe, calk and backfill in the shortest space of time. To accomplish this it was felt that a relatively small and compact working unit would be more satisfactory than a large force spread over many feet of trench.

Confronted with the problem of carrying on the work according to the program outlined, and of holding down costs, modern machines and methods were needed to replace hand labor wherever possible.

The high percentage of rock excavation required, of course, the installation of air compressors and rock drilling equipment for that phase of the work. Experience had proved that calking pipe joints with lead wool meant the employment of pneumatic hammers to insure speedy and satisfactory progress, for it was well known that pneumatic calking is much superior to hand calking for gas-pipe work in the streets of New York City—many of the companies doing all the calking of leadwool joints by pneumatic hammers. With compressed air on the job for such operations, why not apply this convenient power medium to other work to equal advantage? With this idea in mind it was determined to use air tools wherever such procedure seemed at all feasible.

Working in co-operation with engineers from the Ingersoll-Rand Company in selecting equipment, methods were then devised which enabled the work to be carried on in a remarkably efficient manner.

The various operations on which it was deemed advisable to use air power, and the machines employed in each case, were as follows:

Breaking the paving or hard top surface for the trench—pneumatic paving breakers.

Rock excavation—"Jackhamer" drills; used also for breaking up boulders.

Clay and hard sand excavation—Pneumatic picks for loosening the material.

Pipe calking—Pneumatic hammers.

Backfill ramming—Pneumatic hand rammers.

As the ground along the way of the trench varied, no one excavation method was adaptable to all conditions, but operations had to be changed frequently to suit the character of the ground at each point.

Organization

The organization comprised of the following: Engineer in charge, general foreman, 3 excavating foremen, 1 rock foreman, 1 pipe laying foreman, 1 pipe calking foreman, and 1 backfilling foreman. Total 175 to 180 men employed.

The pneumatic equipment included paving breakers, "Jackhamer" drills, pneumatic picks, calking hammers, and backfill rammers.

Four 118-cubic-foot, portable, gasoline-driven compressors and two 210-cubic-foot portable gasoline-driven compressors, having a combined total air capacity of 890 cubic feet per minute.

The selection of the portable compressor units in preference to heavy machines of larger capacity was made because of the following considerations:

1st. The small units could be obtained from stock, which made immediate delivery possible.

2nd. These could be used separately later on for other jobs on which a few air tools would be employed.

3rd. The ease of moving the units from one position to another.

4th. With the small machines, blocking, foundations, housings, etc., were not needed.

Air Pipe Line Along the Trench

A pipe line was laid alongside the trench to which the compressors delivered air through hose connections. The compressor units were all of the wagon-mounted type; and as the work progressed the pipe was taken up in the rear and carried forward and the compressors moved along, one at a time, to new positions.

The first section of trench, starting in Yonkers, ran along the old Rumsey Road, skirting the city. The surface of the road, composed of stones, clay, gravel, and some stone blocks, was almost like a pavement in hardness. Underneath the hard surface, mostly hard clay, filled with many large boulders of all sizes, was encountered. A trenching machine or power shovel would not have proved at all satisfactory because of the many obstructions.

It was here necessary to break the hard surface either by slow and laborious hand picking or, preferably, by hand labor aided by a power machine, such as the paving breaker. The tool, an air-operated hand-hammer drill, recently adopted by many public utility companies for pavement breaking, was well known for its labor-saving possibilities. Paving breakers, each doing the work of ten to fifteen men with hand sledges and chisels, had directed considerable attention to the savings made possible by pneumatic hand tools and had caused operating companies to favor further labor-saving pneumatic machines.

On Rumsey Road, two paving breakers, with one operator for each tool, rapidly broke up the hard top surface so that it could be shoveled out, and easily covered enough ground in a day to permit the trench digging to go forward as planned.

After the top surface of the road over the trench had been removed, it was then necessary to carry the excavation down to the desired depth, taking out the hard clay and boulders. For this work a very recently developed type of tool, known as a "pneumatic pick," was brought into use to do the picking so that the dirt could be removed with hand shovels. These tools have an extension handle so that a man stands in an upright position while "picking." This pneumatic method proved to be very effective and economical.

Pneumatic Picks

The pneumatic pick, for those who are not familiar with this tool, consists of an air hammer with a picking blade held in the nozzle end by a suitable retainer. The blows of the hammer piston drive the blade into the dirt or clay so that chunks are either pried loose or sliced away. Such picks have been extensively used in tunneling through clay, where they have made possible reductions of as high as 40 per cent. in the cost of the work. For trench digging, shaft sinking, open cuts, etc., they are fitted with an extension handle. The weight of the tool, complete, is only 29 pounds. The blades used in the diggers are varied according to whether the work is in hard dirt or clay. For clay the blades are about six by eight inches, scoop or shovel shaped. For earth they are five by nine inches, rectangular, with flat face, one-half inch thick at the top and three-sixteenth inch thick at the bottom, with beveled cutting edge.

In ordinary soil, by the pick and shovel method, one shoveler serves one man with a pick. Using a pneumatic pick, one man could keep five shovelers busy. In other words, the man with the pneumatic pick was able to do as much as five men using ordinary hand picks.

The new tool proved very convenient for working in the clay among the boulders. The operator, after short experience, could soon tell if the blade were striking against a rock and, if so, move the tool to another spot without loss of time. Five of these picks were first installed, but a short time later six more were put at work.

The operation of the pneumatic picks was found much less tiring than swinging a hand pick. Using these tools it was also possible for the shovelers to follow directly after the "picker," and more men could be put into a given space without chance of injury incident to a careless swinging of hand picks.

A good many of the boulders uncovered in the path of the trench were too large to be lifted out and had to be drilled and blasted. For this purpose four "Jackhamer" drills were early brought to the job. These one-man, automatically-rotated drills, easily disposed of such obstructions. It was usually a task of only a few minutes' duration to drill a boulder preparatory to firing. Drilling a boulder in this manner and firing required commonly only half a stick of powder to break it, while mud capping requires five or six sticks—a substantial saving by the rock-drilling method.

Calking Pipe Joints

The next step in the sequence of operations, in which air-operated tools were employed, was calking pipe joints. As previously stated, practically all the gas companies doing work around New York City agree that lead wool, calked in place with pneumatic hammers, makes the very best joint. In fact, in New York City, where the conditions affecting gas lines are severe due to numerous subways, elevated structures and heavy street traffic which cause a great deal of vibration, the pneumatically-calked, lead-wool joint is the only kind which will stand up and stay tight. The lead wool when calked strand by strand ordinarily requires much more labor than the cast-lead joint; but pneumatic calking, on the contrary, takes about half as long as hand calking. The pneumatic method also produces a more uniform and a tighter joint.

In view of these facts, at the beginning of the work, a number of "Little David" calking hammers of the two-inch type were acquired. Six or seven two-men gangs, each gang using two hammers, were kept constantly at work. After the work had progressed for some time, and the organization was running smoothly, an average of two completed joints per man per day was easily maintained. In other words, four man-hours per joint was all the time needed.

Figures obtained from gas companies show the reduction in the time element, with different sizes of pipe, to be as follows:

Size of Pipe	Time by Hand	Time—Pneu. Hammer
12	2½ hrs.	1 hr.
16	4½ hrs.	2½ hrs.
18	....	3 hrs.
20	7 hrs.	4 hrs.
24	11 hrs.	5 hrs.
30	12 hrs.	6 hrs.
36	14 hrs.	7 hrs.
48	18 hrs.	8 hrs.

Pneumatic Rammers for Backfilling

In backfilling, pneumatic rammers, each operated by one man, were used. When working in city streets and on roads, it was found that the air-driven rammers had two big advantages. First, they tamped the dirt much quicker, and, second, tamped it much harder. This resulted in a saving of time, and, furthermore, the harder ramming enabled the men to put most of the dirt back in the trench. It was not necessary to carry away as much excess dirt as with hand ramming, and a saving in cartage charges was effected accordingly. Finally, there was no settlement in the trench.

Comparative average figures on hand and on pneumatic ramming disclose a definite saving with the air tools, apart from their other factors, which make them preferable. This is made if we consider the competitive performances of the two methods when dealing with trench units of 100 feet in length:

Hand ramming—2 rammers, 3 shovelmen,=5 hrs. =25 man-hrs.

Pneumatic ramming—2 rammers, 10 shovelmen,= 1-1/3 hrs.=16 man-hrs.

Saving 9 man-hrs.

At the time of writing this article, the trench had not reached the rocky ground where the customary methods of rock excavation, involving the use of "Jackhamers," would be employed. No records of progress are therefore as yet available for the rock work.—R. A. Lundell in "Compressed Air."

Pouring 1600 Cu. Yards of Concrete per Day

An Average of 100 Yards per Hour Has Been Maintained on the Hetch Hetchy Dam Which is a Project of Unusual Interest From Many Points of View

Our readers will find much to interest them in a description of the construction of the Hetch Hetchy dam which is a part of the new water and power project being carried out by the City of San Francisco. About 500 men are working at the dam site, in material yards, camps and on the dam itself. An average of 100 cu. yd. of concrete is being poured per hour during the usual 16 hour day and in the month of May, working 53 out of a possible 62 shifts, 41,178 cu. yd. were placed. On Sept. 1 about 295,000 cu. yd. had been placed in the structure.

In addition to being of interest because of its size and height (the present contract calls for placing 365.000 cu. yd. of concrete and will carry the structure to a height of 344 ft.) some of the construction features of interest are the use of bulk cement, the success in developing porous concrete blocks for drainage wells, the use of a 350 ft. concrete tower for the spouting system, an effective system of aligning forms and the method of concreting around large valves to prevent forcing them out of shape. The first concrete was poured in August, 1921, and despite some delay due to power shortage, it is expected that the work will be finished by the end of this year. An article on the Hetch Hetchy dam appears in "Engineering News-Record," and it is reprinted herewith:

The dam is of the gravity type, curved in plan on a radius of 700 ft. In addition to the 23 x 25 ft. tunnel used as a bypass during construction in which three 36 in. needle valves will be installed, other outlets will consist of four batteries of conduits arranged at different levels, three sets of two 5 ft. in diameter and one set of three 3½ ft. in diameter. All of these will be controlled by balanced needle valves.

During the low-water season the three 3 ft. balanced needle valves are to be put in the bypass tunnel. As a precaution to aid in effecting closure of the dam in case of an unusually wet season next year, a 12 ft. opening of horseshoe shape was left through the middle of the dam at the same level as the bypass tunnel, i.e., just above the level where the full width of the foundation was discontinued. After it has served its purpose this opening is designed to be closed by stop logs on the upper face of the dam while the concrete plug is being placed.

The materials handling plant is located on a slight eminence in the reservoir about half a mile above the dam. This was the most convenient place where sufficient room was available and it was planned to crush there the rock hauled from a pit about 1½ miles farther up the reservoir and to wash fines from the gravel accompanying the rock. Several new factors have entered since beginning work which have required rearranging the plant. For example, after some experiment the material accompanying the rock was rejected and the railroad was continued to a sandpit about 2¼ miles farther up on the floor of the reservoir. Thus material from the rock pit is washed and the washings are wasted. Sand from the new sandpit is passed through a screening plant recently added and is stored in a separate stockpile, while the reject goes in with the product of the primary crusher.

Delay due to breaking the single primary rock crusher which was first installed led to the installation of a second crusher that was used until repairs could be made on the broken unit and since then has been kept ready for similar emergencies. The first primary crusher is of the gyratory type, while the reserve unit is of the jaw type. Both are set to pass 4 in. rock and each has a capacity of 200 cu. yd. per hour which is sufficient to keep the mixer plant running at capacity.

The rock is washed once in the rotary screen above the secondary crushers. There are two of these of equal capacity set to clear 2½ in. rock. Neither is large enough to keep the mixer plant operating at full capacity, but by keeping a considerable rock storage ahead, minor repairs can be made without delaying the work.

A stratum of very fine sand that came from the sandpits caked by moisture, rolled up in lumps in the perforated metal screen and passed out with the reject. This was a decided loss as fines were urgently needed. The difficulty was entirely remedied by substituting wire mesh for the perforated metal screens. Crusher dust is screened dry so as to avoid the loss of fines, and everything passing the ¼ in. screen goes into the sand pile.

As an afterthought it has been made possible to store a supply of gravel between ¼ in. and 1 in. size which is very convenient for concrete used in screen racks or wherever gravel serves better than crushed rock. This material is secured by placing an inclined screen with 1 in. perforations in the chute conveying the reject from the ¼ in. sand screen to the rock crushers.

The original plan was to have all materials in one large stockpile, the sand at one end and crushed rock at the other. Since the addition of the separate sand storage pile, only a small amount of sand storage is maintained at one end of the rock pile. The capacity of rock storage is about 8,000 cu. yd. and the total sand storage is about 5,000 cu. yd. In loading the 12 car trains of 4 cu. yd. dump cars the train first backs under the sand pile and when the sand cars have been loaded the train is moved under the rock storage for the remainder of its load.

At the mixer plant these trains dump into receiving hoppers whence the material is elevated by belt conveyors to a 3 bin bunker. Each bin has a capacity of 250 cu. yd., the center one being used for sand and the two outer bins for rock. This plan makes possible the convenient arrangement of chutes direct from sand and gravel bins to each mixer.

Cement Handled in Bulk

The plant for handling cement in bulk is very satisfactory. Each charge of cement is still weighed by hand as the automatic feature was not considered dependable. However, with an operator on each machine there has been no difficulty in delivering batches at an average interval of two minutes. With the proportions now used the richer mix takes 960 lb. of cement per batch and the leaner mix 799 lb. per batch.

There was some difficulty in getting this quantity of cement into the weighing compartment without delay and this was overcome by putting a ½ in. air pipe into the cement hopper just above the radial gate and directing its nozzle upward. By turning on the air when the hopper gate is open any tendency to arch or clog is prevented.

White, red or green signal lights are burned continuously on the weighing house to indicate to workmen on other parts of the job whether the rich or the lean mix is being delivered; red indicating for one scale, and green for the other. The same plan is followed at the head of the spouting system so the foreman on the dam knows when to change the point of delivery. A 1:3:6 mix is used in the body of the dam and a 1:2½:5 mixture is placed in the 5 ft. next to the upstream face, along the downstream face of the spillway and at certain other designated sections.

The cement from the measuring room is delivered to concrete mixers through two 8 in steel pipes which drop the cement about 180 ft. on a 1 to 1 slope. During cold weather when hot water was used for mixing concrete, steam rising in these cement pipes had a tendency to cause clogging. There was also the entrance of some rainwater at pipe joints. The joints were tarred to make them watertight and 8 in. vent pipes about 30 ft. long and curved downward at the upper ends were put into the receiving hoppers at the foot of the cement pipe to prevent the accumulation of pressure and to serve as a vent for water vapor. No pouring was done during zero weather. Cold weather limit was fixed at 20 degrees on a rising thermometer.

100 Yards Per Hour Normally

The mixing plant consists of two 2 cu. yd. batch mixers driven by 50 h.p. motors and which ordinarily turn out 100 cu. yd. of concrete per hour. The maximum pour of 2,000 cu. yd. has been attained in a 16 hour run. The mixer operator manipulates all levers controlling the admission of materials into the mixer. With the exception of the water valve, all these gates are operated by water pressure. The sand and gravel measuring hoppers are located close to the outlet from the bin above so that when the measuring hopper is full it automatically chokes and the radial gate from the bin above can be closed at any time before the outlet from the measuring box is opened again.

Each batch is mixed a full minute. Charging and discharging occupy about another minute, so that normally a batch is delivered once every two minutes.

Each mixer discharges through a hopper that delivers to either of two skips which in turn deliver to a hopper which is changed to various levels in the tower at the head of the chute system as the work progresses. At this point a hopper capacity of about two batches has been found convenient in regulating the flow through the chute, in avoiding stoppages and maintaining continuous delivery. A separate chute system is used for each mixer, but the capacity of each chute is sufficient to take the output from both mixers whenever there is occasion for concentrating this delivery.

The surface of the dam on which concrete is being poured is kept higher at the downstream edge than at the upstream edge, giving the concrete a downward slope of about 10 degrees toward the upstream face of the dam. This facilitates hosing off the surface by affording a good slope for drainage and it also eliminates the possibility of any weakness due to existence of construction joints in a horizontal plane or sloping downstream. In addition to this slope of the working surface, risers or vertical steps 5 ft. high parallel to the axis of the dam are occasionally put in to break the uniformity of the slope. This is accomplished by pouring concrete against a longitudinal run of forms which are removed before the next section is poured.

Before pouring concrete on the sloping top of the dam the surface of the previous pour is brushed with wire brushes and thoroughly hosed with water from a 1½ in. hose under a head of 300 ft. This phase of the work involves considerable time as concrete is poured, at maximum section, on an area of about one acre which has to be gone over every six or seven days In addition to washing and brushing, all surfaces against which fresh concrete is poured are thoroughly wet down just before pouring. During the winter months this calls for minor attention but the hot dry winds of summer greatly increase the hosing.

Forms

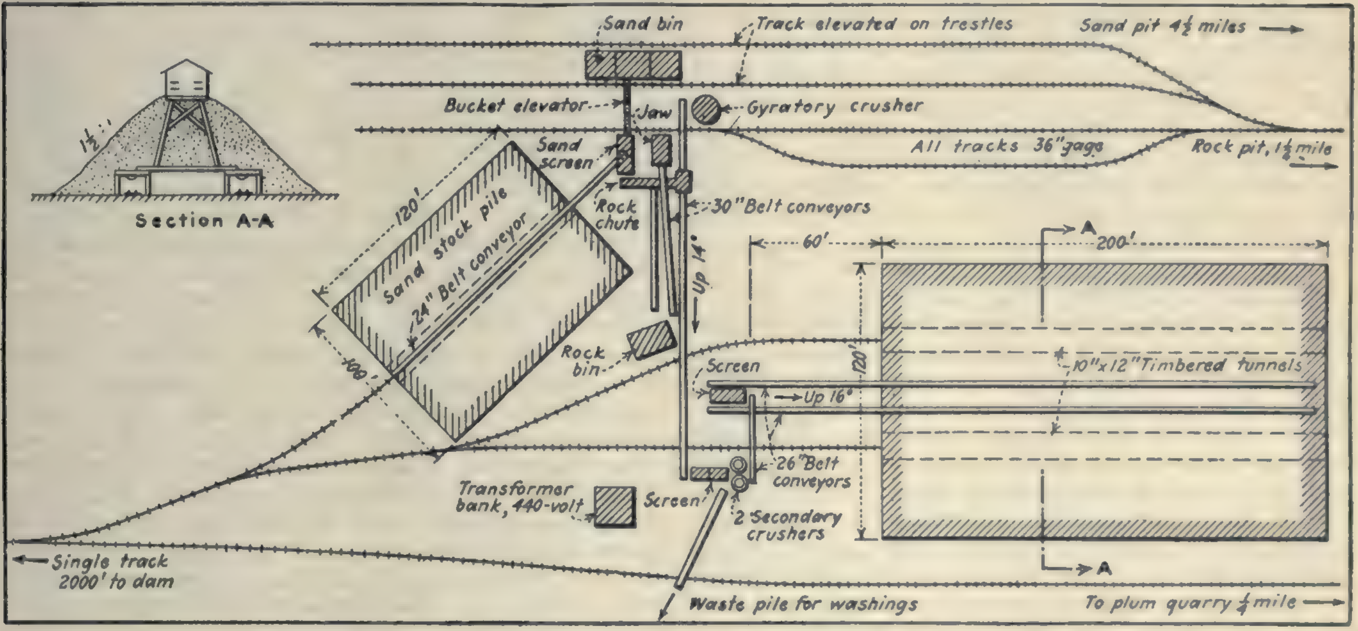
The standard forms used on the dam are made up in 5 x 8 ft. panels consisting of 1 x 6 in. tongue-and-groove flooring on 2 x 6 in. studding spaced 2 ft. on centers. Some of these panels have been used continuously for nine months. When warped and cracked due to the alternate wetting and drying the flooring is taken off and the panel re-surfaced. No oil is used on the forms.

The accurate alignment of form panels is given careful attention. When each 5 ft. lift of concrete has taken its initial set the up- and downstream faces of the dam are surveyed and exact locations of the prescribed limits of the structure are marked every 8 ft. In placing the next tier of forms the bottom edge is set to match the top of the forms last placed, whether these are slightly out of alignment or not and the exact locations marked by transit are used to true up the tops of the newly placed panels. Thus slight inaccuracies are corrected without abrupt changes in slope.

The level to which each 5 ft. lift should come is also marked on each new tier of forms by the surveyors, and the carpenters tack a molding along the forms at this level to indicate to the concrete foreman the limit to which he is to pour. This level is usually 1 to 3 in. below the top of the panel.

The form panels are held in place by nine pairs of twisted wires and two rows of pipes, three in each row, which serve as struts to take compression as the wires are twisted taut. The wires are slipped through loops embedded in the concrete and are passed around the outside studding of the forms in the usual way. The struts are made of old pieces of pipe, 1 to 2 in. in diameter. Lengths used in the lower row are about 2½ ft. long and in the upper row about 7 ft. long. At their lower ends the pipes are braced against the rough surface of the concrete and at the top they are wedged under the notch in a short piece of dimension lumber cut for the purpose. This is tacked lightly into place so the nails can be loosened easily with a shovel used as a pry, after which the pipe is loose and can be removed easily. The pipes are pulled out the same day the concrete is poured, usually as soon as the fresh concrete, by its thrust against the form, balances the tension of the wires.

Forms are moved upward as work progresses so that little or no problem of form storage exists. At the present stage of the work it takes from six to seven days to complete a pour over the entire top of the dam. This gives ample time for setting and the forms are raised about once a week. The usual plan is to pour each 5 ft. lift in two operations, a depth of about 2½ ft. being placed each time and the area worked being small enough so that the second pour can be made before the first has set.



Arrangement of storage piles and other items of construction plant on the Hetch Hetchy dam

Concrete Gang

Each concrete gang on the dam consists of six men and a foreman. Five of these men, including the foreman, use shovels a large part of the time and the sixth man is stationed on the chute to clear stoppages and help in manipulating the pulley ropes when shifting the delivery point. The shovel men devote attention chiefly to seeing that the concrete is well spaded alongside of forms, around plums and at the toe of the natural slope of the concrete where honeycombing might otherwise occur. The amount of water in the concrete is so regulated that as delivered on the top of the dam it will take a slope of about 20 degrees.

Not less than 10 per cent. of the total volume of the dam is to consist of plums, according to the contract, and these are usually placed in large sizes, rock up to 5 tons in weight having been put in. The plums are quarried in a talus slope about three-quarters of a mile above the dam where they are loaded into skips on flat cars which deliver them to derricks on each end of the dam. The plums are delivered to place in the structure by derricks; at the present stage of the work two 10 ton derricks, set on pedestals and equipped with 110 ft. booms serve the major portion of the dam. The pedestals are about 15 ft. square and as there is need for raising them they are built up 50 to 75 ft. above the surface of the finished work. When a new pedestal is ready the derrick is set up on it about two days. Plums previously washed and cleaned of soil are placed on top of each 5 ft. layer of concrete at the time of pouring or immediately thereafter. They sink into the concrete by their own weight but project enough to give good bond for successive pours. Only one round of plums is placed in each 5 ft. pour.

Porous Blocks for Drainage

Porous concrete blocks were decided upon for drainage wells because it was believed that they would give the maximum drainage perimeter with the least weakening of the structure or sacrifice of weight. The blocks are precast in a yard on the floor of the reservoir and are made 3 ft. 3 in. square and 3 ft. high with a central cored opening 15 in. square. After some experiment it was found that the ideal combination for maximum weight and porosity was a 1:1:8 mix, using rock from ¼ to 1 in. size. Blocks made of this material weigh 3,440 lb. per cu. yd. and show a strength in compression of 994 lb. per sq in. after twenty-eight days. Satisfactory porosity is shown by the fact that a stream from a 2 in. pipe turned against the side of the block all passes through. They are strong enough to be handled very easily and forms are often removed after three days.

At first the blocks were provided with a loop of reinforcing steel embedded in each side to facilitate handling. This was found unnecessary and a depression 1 in. deep is now made in each block about 5 in. below the top. The blocks are lifted by grab hooks which fit into these depressions, the grab hooks being slung from chains and lifted by the derrick. About 1,600 of these blocks have been made of which 750 have already been placed in the dam with practically no breakage. The porous blocks are placed in the bottom of the cutoff trench for its full length, and also in vertical tiers. The latter are 50 ft. apart below stream bed level, and 12 ft. apart from stream bed to top of the dam. As set in place on the structure about two sections are kept above the level of fresh concrete and the central opening is protected by a wood cover to prevent debris from falling down the well.

Two 8 hour shifts are worked at the dam. The first shift is on from 6 a.m. to 3 p.m. with a lunch hour from 11 to 12. The second shift works from 4 p.m. to 1 a.m. Except for carpenters who do not work during the second shift, the crews on the dam are the same in both shifts.

Lighting for the second shift is provided by 1,000 watt lamps in dome-type reflectors strung about 150 ft. above the surface of the concrete. It would be desirable to have these nearer the work but it has not been convenient to place them below the derrick guys and other lines, so the overhead lamps, of which six are usually used, are supplemented by three or four additional lamps attached to the tower or convenient points lower down.

In an endeavor to profit by experience on other large dams where the large needle valve castings have been forced out of shape by the concrete in process of setting, special precautions are taken in pouring the concrete around the 5 ft. needle valves which are now being placed. The main valve castings are not embedded in the concrete which is poured with the main body of the dam. Instead a 3 ft. space is maintained by supplementary form work entirely around the valve setting. When ready for finally embedding the valve in concrete, the casting is held rigidly in the exact position desired by short pieces of railroad iron wedged against both inside and outside of the casting. Concrete is then carefully poured around the casting, the bracing outside being embedded by the concrete and left permanently in place.

All seams in the foundation were excavated to solid rock before concreting began, but in the upper portions of the canyon wall, as small seams are encountered, 1½ in. pipes are inserted in them and carried up about 20 ft. When this amount of concrete has been poured above the seam, grout is forced in through the pipe. Due to the considerable height of the structure the side walls were not readily accessible before construction began. Now that they can be easily reached they are again being gone over and all loose material barred down. Water-worn surfaces are either sand-blasted or drilled and shot.

No coal or fuel oil is used on the job. About 22,000 cords of wood, cut in the process of clearing the reservoir and floated down to the dam, is used under the boilers of dinkies, derricks and wherever power other than electricity is required.

The Permanent Construction Co., Ltd., Tegler Bldg., Edmonton, Alta., are moving their offices to the Pacific Bldg., 102nd. Avenue.

Steel Bridge a Mile Long, to be Built at Castleton, N. Y.

After a controversy lasting some ten years, the New York Central Railway has decided to go ahead with their bridge across the Hudson River at Castleton, N. Y. Twelve miles of track is being built at the same time, and these improvements will do away with the heavy grades and congested yard trackage between Albany and Schenectady. Ultimately all through freight for Boston and New York will be diverted over this new cut off. The grades on the new track will be 0.35 and 0.60 against westbound and eastbound traffic respectively, while the grades on the old line were 1.63 and 0.75 respectively.

The controversy started over the opposition of the Albany and the New York State interests to the construction of a pier near the centre of the stream. These interests by state legislation and law-suits endeavoured to compel construction of a single span structure more than 1,100 feet long between main piers. A design of this kind was worked out using a cantilever of 1,130 feet main span and 1,748 feet total length, together with the necessary approach viaducts. The weight of this structure would have been approximately 41,000 tons, or almost twice as much as the one finally adopted which was 23,000 tons for the superstructure. Difficulties of financing the project due to the war held it up still longer and the contract was not let until this year.

Steel is Cheapest

The contract calls for two single truss spans over the river, the channel span of 601 feet 6 inches from centre to centre of piers and the side span of 409 feet 2 inches. They have curved top chords with a subdivided web system. The viaduct portions were given considerable study as regards the materials of construction. When the first estimates were prepared some years ago it was found that concrete approach spans would be cheaper, but with the current prices of materials, structural steel towers and girders were found to be more economical. The height of the piers controlled the spans of the girders and it was decided that the most practicable distances would be 64 feet for the tower spans and 100 feet for intermediate spans.

Reunion of Engineering Alumni, University of Toronto

A grand reunion of "School" graduates is scheduled to take place on October 27 and 28. The committee in charge has arranged a programme that ensures a large attendance; it includes class luncheons, a dinner dance and the Queen's vs. Varsity game on the 28th. An announcement of the reunion is worded as follows:—"These meetings have grown into a golden opportunity to revive old college memories and to renew old friendships. They are becoming part of the School tradition of loyalty and unity.—Come and enjoy yourselves in the old familiar haunts. Carry away with you fresh enthusiasm to build Varsity ideals into business and fresh inspiration to carry on the loyal traditions of the old School." Judging from the favorable comment that is heard among School men in general, this present reunion should to be one of the most successful. The old spirit is as strong as ever, and every man that possibly can is going to be there and shout Toike Oike again.

What is Wrong with Most Concrete Proportioning Theories?

Light is Thrown on Some Fallacies in Commonly Accepted Methods of Mixing Concrete—What is Involved in Correct Proportioning?—Will an Easy System be Found?

By G. M. WILLIAMS, A.M.E.I.C.
Professor of Civil Engineering, University of Saskatchewan

Before the Saskatchewan Branch of the Engineering Institute of Canada

During the past twenty years concrete has taken its place as one of the most useful and important of structural materials. Owing to the comparative ease with which it can be molded into any desired shape its structural uses are almost unlimited and its characteristics have resulted in its displacing older materials for certain classes of work wherever portland cement can be obtained and suitable aggregates are available. The apparent ease with which concrete can be prepared has not confined it to use under the supervision of engineers as is the case of some types of engineering materials, but we find it employed by everyone who feels that the material is suited to his particular purpose. In many cases where proper skill is not at hand, concrete is little more than a bulky substance, lacking in great part the strength and other properties which should be attained, and often failing to fulfill the purpose for which it is intended.

To most users of cement who obtain such results, concrete is merely a shoveled-together mass of cement, aggregate and water which in a short time attains a certain degree of hardness and strength. To the engineer and skilled user who is more or less familiar with the many factors and variables which enter into its manufacture, the process of concrete making does not appear quite so elementary or so certain of results. Experience soon teaches that quantity and quality of cement, aggregate and mixing water, processes of mixing and curing are all involved in the production of concrete. Results are dependent upon all these variable factors and it is the problem of the engineer to so control and vary these factors that a concrete having the desired physical qualities will result. To the onlooker the manufacture of concrete merely means the dumping of cement, aggregate and water into a mixer, thence transporting and dumping the wet mass into a mold which has been conveniently arranged in advance to receive it, but to the engineer the procedure is far more complex.

The Proportioning Problem

The manufacture of portland cement itself is a large scale commercial operation carried on in large centralized plants under rigid and skillful control, and quality of the resulting product can be determined by certain standardized tests which are in general use. Likewise practical experience in actual construction work, together with laboratory investigations have resulted in a theory of design of reinforced members which is fully adequate and furnishes structures which favorably compare in cost and strength with the older types of structural materials. With a concrete of known quality the strength of the members composing a structure may be accurately computed and the values verified by actual tests when necessary. But, it is the problem of producing a concrete of definite and specified quality, with the many types of aggregates available, which has not been worked out to the satisfaction of engineers. The two other important elements, cement quality and design theory, have been well standardized, but the proper use of available aggregates to produce a definite quality of concrete is a constant source of worry to the engineer. To most engineers the discovery of some formula or equation in which he can substitute the variable factors as represented by his materials and job conditions and obtain by means of a slide rule such an answer as 1—2—4 or 1—3—6 would seem the ideal solution of the problem, and to this end numerous proportioning theories have been advanced, generally supported by more or less complete test data which appear to verify the correctness of the theory.

Before taking up several of these proposed proportioning theories in detail, it will be well to consider the present status of our knowledge of concrete and some of the factors which have influenced its formation. Years ago when concrete first came into general use it was common practice to use a very dry consistency, the concrete being so stiff that a considerable tamping was required to bring moisture to the surface. Tests made in some localities showed such a concrete to have a compressive strength of about 2,000 pounds per square inch at twenty-eight days when proportioned by volume, one cement, two fine and four coarse aggregates. Standard specifications for concrete as well as many individual specifications in the past have assumed 2,000 pounds as ultimate strength in structural design and called for a 1—2—4 volume concrete to be furnished. Lack of tests of field concrete has caused the continued use of these false assumptions, since it is now recognized that the cements and aggregates available in many localities cannot give a strength in excess of 800 to 1,500 pounds per square inch in such a proportion where workable consistencies are employed. Proper methods of inspection and test have shown that such a specification is inadequate to result in concrete of desired quality and the most discussed section of the proposed Joint Committee Specifications for Concrete and Reinforced Concrete, now being prepared in the United States, is that one which relates to the quality of concrete and a method of obtaining it.

Effect of Mixing Water

While it has been known for years that quantity of mixing water has a very great influence upon concrete strength, regulation and measurement of consistency has generally been ignored in past specifications. Tests have shown that the use of excess mixing water, beyond that needed to result in a concrete which is practicable to place, may reduce the strength to less than 50 per cent of that which might be obtained with the same cement content. That such a condition could have existed for so long a time is no doubt due to the fact that no satisfactory means were available for measuring and describing consistency. Within recent years two types of apparatus have come into use, (a) the slump test, and (b) the flow table.

The Slump Test

The slump test method was first used extensively in the field for controlling the consistency of concrete ships by the Emergency Fleet Corporation. As first used it consisted of a cylindrcal steel form such as is used for moulding 6-inch by 12-inch cylindrical test specimens. This mold is filled in the usual manner and withdrawn vertically and the resulting height, in inches, of the concrete mass subtracted from twelve, is known as the "slump." This apparatus is not sufficiently reliable or accurate to be adopted as a standard measure of consistency, since concretes having the same slump but varying in cement content or aggregate gradation may have widely different consistencies or flowabilities. On any job where the aggregate from day to day differs little in gradation, the slump apparatus will be found very useful in establishing a definite limiting value for consistency which must not be exceeded. However, in all cases a placeable concrete must be employed and the slump figure must be based upon the conditions of the particular job. The slump value cannot be arbitrarily established in advance except by previous experience with the same aggregates and cement quantities. The slump test apparatus can be made of much assistance in field work where its limitations are recognized, but any attempt to establish definite slump values in advance to apply to concrete on all classes of work and with widely varying aggregate gradations, is absurd.

The Flow Table

To supply the need for a consistency measuring apparatus that would be suitable and accurate enough for both field and laboratory practice the flow table was devised and standardized in the concrete laboratory of the Bureau of Standards. This consists of a metal covered table top mounted by means of a flanged coupling to the end of a short vertical shaft which carries at its lower end an adjustable bolt. Below the bolt is a cam having a throw of one and one-half inch attached to a horizontal shaft which is rotated by hand. One revolution raises the table top vertically and allows it to drop freely through a distance of one-half inch. Mortar or concrete is molded in a sheet metal form having the shape of a hollow frustrum of a cone, the form is removed and the table top raised and dropped fifteen times. The concrete mass flattens and flows out concentrically similar to a mass of concrete in pouring a floor slab when the wood form is vibrated. The spread, in inches, of the concrete on the table under the repeated bumping action divided by the original diameter and multiplied by one hundred is called the "flowability" figure. Tests show that flowability of any given cement-aggregate combination is directly proportional to change in quantity of mixing water, within the widest working limits of consistency, and that is also proportional to velocity of flow in a steel chute. Continuous use of the flow table during the past three years, both in laboratory and in the field has fully demonstrated its ability to accurately measure the consistency of concretes varying most widely in cement content and aggregate gradations.

Measurement of consistency has been dealt with in detail in the preceding paragraphs owing to the necessity for having a definite measure for this property of concrete, since compressive strength is in turn so greatly influenced by the water content. In studying proportioning theories and measuring the concrete making qualities of widely different types and gradings of aggregates, it is of fundamental importance that the consistencies of these concretes be equal. In the field the conditions of the work, such as size and shape of forms and quantity and arrangement of reinforcing steel, automatically establish a limit of dryness which cannot be exceeded, but in the laboratory, where a great amount of energy may be expended in molding a small test piece, the limitation as to dryness is not so apparent, and some mixtures, owing to difference of aggregate gradings, may actually be much stiffer than others. Superior strengths obtained for some under such conditions are not due to better concrete making qualities of the aggregate but to the use of a smaller quantity of mixing water and one which would prove to be inadequate under field conditions. The use of the flow table will result in the elimination of the consistency variable. A second fundamental consideration in making comparative tests is the necessity for equal cement contents per unit volumes. Although dry proportions of materials in all batches may be the same, the cement content in the wet concretes may differ owing to the greater bulking effect or swelling of the mass when water is added. Since cement is the most expensive ingredient and also the only strength furnishing component, it is essential that its quantity be the same in all concretes being compared.

Since most of the proportioning theories which have been advanced deal with the selection of the aggregate it is a basic requirement that the variable factors, cement content and consistency, be eliminated and made constants in comparative tests. As described above, equal consistencies can be assured by use of the flow table and equal cement contents can be provided by calculating quantities of cement actually present in trial batches and by making proper adjustment of proportions when necessary.

With the preceding considerations in mind a number of the methods and theories proposed in the past for proportioning concrete will be discussed briefly. In general the methods proposed during the early years of the development of concreting practice were concerned with the best combinations of aggregate particles, with no attempt to predict strengths or satisfy specification requirements for strength. The water-cement ratio theory and the surface area theory of more recent years have attempted to furnish a means of producing concrete of any desired quality with wide variations in aggregate gradings, so long as the strength which will result from any single grading is known.

Arbitrary Volume Proportions

This process is a method of proportioning rather than a theory. There are no considerations either practical or scientific which justify the use of arbitrary volume proportions. As stated previously, the almost universal assumption that the proportions by volume of a 1 cement, plus 2 fine aggregate, plus 4 coarse aggregate will provide a concrete having a compressive strength of 2,000 pounds at 28 days is an example. This method fails to take into account the varying concrete making properties of different aggregates as well as variation in cement quality and its general use, in specifications for concrete, well illustrates the lack of knowledge of the various factors involved in the process of concrete making as well as failure to test concrete as placed on the job to insure that the specification requirement is being met.

Void Method of Proportioning

Several variations of the void method of proportioning have been proposed. In each case the idea has been to produce a concrete in which the void space will be a minimum. The assumption that the voids in coarse aggregate can be filled with sand particles and those of the sand with cement is, of course, erroneous since the smaller particles while partially filling void space also wedge apart the coarser particles. The best of concrete usually contains over 20 per cent. void space, the higher the cement content the greater the void space and concretes having practically the same void space may differ several hundred per cent. in compressive strength. In any case, after obtaining such an aggregate combination that the smallest possible void content will result, the strengths which will be attained by different cement contents must be determined by actual tests of the concretes. There is no feature in this method which permits the prediction of strength values and it is of little practical importance to the engineer.

Fuller's Theory of Maximum Density

In this theory the assumption is made that with fixed cement content, an aggregate combined with cement, so graded as to have maximum density, will have maximum strength. It is claimed that with the same cement content strength will increase with increase in density. Such density increase can be obtained by regrading the aggregate. Sand and gravel or stone are separated into a number of sizes and re-combined so as to have a grading which will coincide with the "ideal" grading curve, or curve of maximum density, which was stated to be a combination of an ellipse and a straight line.

However, tests of aggregates from numerous sources show that an aggregate can be screened and re-combined to have widely different gradings and yet produce concretes of approximately the same quality. Also with fine aggregates of the same grading, the relative proportions of fine and coarse aggregates may be so varied as to range over a broad zone when plotted graphically, and also produce concretes of different densities, but of approximately the same compressive strength. With the same cement content and aggregates from the same source of supply, the concretes of high density will usually have a relatively high compressive strength, but by changing the aggregate grading or by modifying the relative proportions of fine and coarse aggregate of the same grading a considerable decrease in density may result without lowering compressive strength. An aggregate so graded as to coincide with the "ideal" curve will often be lacking in fine particles, producing a harsh working concrete which segregates badly in the higher flowabilities.

The maximum density theory of proportioning is one application of the void theory. With equal cement contents the trend of increased strength with increased density is generally apparent, but in any case there may be so great a variation in density without lowering strength that it is difficult to see how the density factor can be made a criterion.

Surface Area Theory of Proportioning Concrete

The surface area theory of proportioning concrete assumes that strength is dependent upon the ratio of the weight of cement to surface area of the aggregate; that for a group of aggregates having different gradings and consequently different areas, and with cement content proportioned to surface area, equal strengths will be obtained. A water formula was proposed which it was claimed would result in equal consistencies for such a group of mortars and concretes. However, tests have shown that:

(a) This water formula furnishes such a quantity of water in each case that equal water-cement ratios will result; that is, the cement pastes alone will have equal consistencies with no allowance for the varying requirements of the sands which may differ greatly in surface area or fineness.

(b) The important property of surface area does not enter into the determination of the quantity of mixing water, except insofar as it fixes the quantity of cement at the beginning.

(c) The formula is not only incorrect in theory, but inadequate in practice and furnishes mortars and concretes varying widely in consistency, which are therefore in no sense comparable on the basis of strength.

(d) A normal sand may be regraded and so increased in fineness as to double the surface area and yet produce a concrete, with the same cement and flowability, equal in strength to the mixture containing the normally graded sand having one-half the surface area.

(e) Not only the grading of a sand, but the relative quantity of sand in the mix may vary within wide limits without lowering compressive strength.

(f) It is quite evident that the author of this theory had no means of measuring and controlling consistency, since reproduction of the mortars and concretes used in his work varied widely in this respect and showed equally wide variations in compressive strength, although it was stated that the water formula would insure equal consistencies and equal strengths would be attained.

Water-Cement Ratio Theory of Proportioning Concrete

This theory has been developed and given prominence by the Lewis Institute Laboratory of the Portland Cement Association. This theory assumes that strength of concrete is dependent upon the ratio of the volume of mixing water to the volume of cement in the mix so long as the concrete is plastic and workable. It is further claimed that aggregates having the same fineness modulus will require the same quantity of mixing water to result in the same consistency or flowability when cement contents are equal. Quantity of mixing water which it is stated will result in any desired consistency may be computed from a water formula which involves the factors of cement content, fineness modulus and absorption of aggregate, and a constant water-cement ratio will result for all aggregates having the same fineness modulus.

This water formula, however, is based upon the same erroneous assumption as is the one proposed for the surface area theory of proportioning. It provides sufficient water to bring the neat cement pastes in the mixture to the same consistency, but does not make allowance for the varying water requirements of the aggregates which for the same fineness modulus may vary as much as 600 per cent. in surface area or fineness. The resulting concretes are not comparable owing to the wide variations in consistency. To add more water to the drier consistencies, so that they may be made comparable, results in the loss of the constant w|c relation, which is the foundation upon which the theory has been built, and which is the assumed criterion for equal strengths. Tests show that, (1) the proposed water formula does not result in comparable concretes having the same consistency, and (2) even though the fundamental requirement that concretes must have the same consistence be waived, concretes prepared in this manner with a constant w|c may vary widely in compressive strength.

A full description of the water-cement ratio theory of proportioning concrete is contained in Lewis Institute Bulletin No. 1, issued in 1919, entitled, "Design of Concrete Mixtures." Test data which is intended to prove the correctness of the theory is given in table 2, in which are shown twenty-seven different aggregate gradings, having the same fineness modulus 6.04 and each of which when combined in a 1—5 volume concrete is claimed to have the same consistency when equal quantities of mixing water are employed. Figures are also given which show that the surface area of aggregate per pound of cement varied from 390 to 1,992, or more than 500 per cent., which indicates the wide variation in gradings which may be had with the same fineness modulus.

Tests in other laboratories have demonstrated that the above claims are not true. These gradings were carefully duplicated and it was found that wide differences in consistency resulted both as measured by the slump test and also by the flow table. Some concretes were so stiff that the slump was zero, and the wet unsupported mass could be picked up in the hands and carried back to the mixer without losing its shape, while other mixtures were almost soupy in consistency. Even though such wide consistency differences do not permit of fair strength comparisons, compression test pieces were molded from each and the strengths at twenty-eight days were found to vary more than 30 per cent. The addition of more water to the dry or less water to the wetter mixtures, to result in the same consistency, of course destroys the constant water-cement ratio which is the basis of the theory of proportioning. Such results as were found, when these gradings were duplicated, clearly show that not even the slump test, inaccurate as it is, was employed to determine the consistency of the different mixtures which are included to prove the correctness of the theory.

The wide publicity which has been given to this theory has been of some benefit in that it has emphasized the injurious effect of excess mixing water beyond that amount required to produce a mixture having the minimum flowability required for the work at hand. However, contrary to the impression held by some, this effect of excess water is not an essential element in the proportioning theory advanced nor was this injurious effect discovered in working out this theory. That excess of water will reduce compressive strength has long been known to engineers who have been familiar with laboratory investigations of concrete and warnings that mixing water should always be held to a minimum have been given in earlier publications.

Effect of Over Sanding

If the water-cement ratio theory of proportioning were correct we should be unable to use sands such as beach sands, or use "oversanded mixtures" without reducing compressive strength. Yet tests show that fine sands, as well as excess of sand, in the mix, within rather wide limits, do not lower strength, and on the other hand furnish concretes having superior working qualities due to their small tendency to segregate in the wetter consistencies which must often be employed.

Both the surface area and water-cement ratio theories of proportioning are fully discredited by a consideration of the very test data which the authors have advanced to support their respective theories, since sound principles of testing were violated in obtaining their test results. Had proper testing methods been employed in both laboratories and had proper appreciation of the fundamentals, which cannot be disregarded in testing work, been existent, there seems to be little doubt that these theories would never have been presented to the public.

Will an Easy Means of Proportioning Ever Be Found?

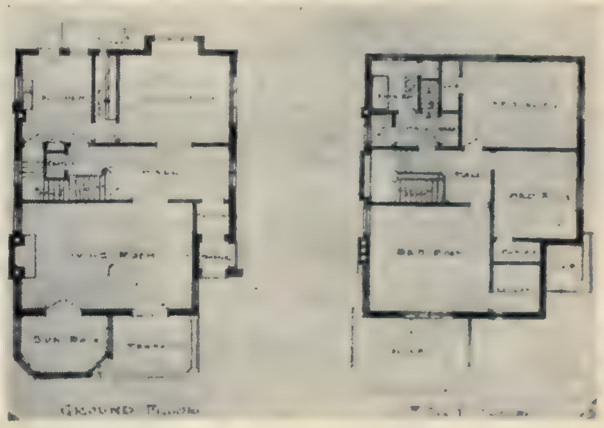
While the discussion of both theories has done much to focus the attention of engineers on the feature of concrete proportioning, which is worthy of far more attention than has been accorded it in the past, both have failed to furnish the engineer with that much desired formula or equation which will permit specifying in advance quantities of materials to result in concrete of definite quality. After consideration of what has been brought out along such lines during the past few years it seems quite safe to say that such a short cut, for universal application, will not be found, but that the desired standard of concrete quality can be obtained and maintained only by co-operation between the testing laboratory and the field engineer, coupled with observation and experience. A little work properly planned will permit the determination of the approximate concrete making qualities of aggregates from our main sources of supply, and a proper system of inspection and testing on all work of importance will permit of such modifications as are needed from time to time to correct for variations in cement and aggregate quality as well as other factors, beyond control, which tend to affect the strength of concrete. For aggregates and cements in use in any locality from year to year there is no reason why fairly accurate combinations cannot be tabulated to produce concrete of any desired quality under known conditions. Experience and field tests will soon indicate the importance of the other variable factors which tend to influence quality and point out changes in proportions which must be made at times.

The Contract Record's

Weekly House Suggestion No. 39

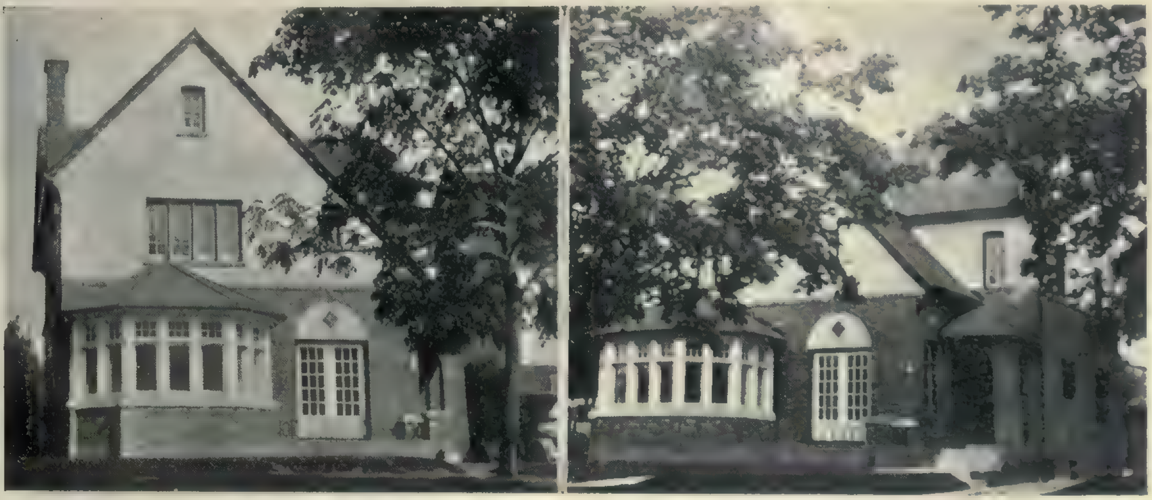
We are showing herewith two front exterior views and floor plans of an attractive residence recently completed on Inglewood Drive, in Moore Park, one of Toronto's beautiful residential sections. The general construction of this house is vari-colored rug brick to the second floor and stucco on tile above. A very pleasing and decorative feature is the small tile-floored terrace, which opens through double glass doors on the living room. The main entrance is on the right side of the house and is finished with a wrought iron railing. Entrance is on a covered porch, which, in turn, opens on a vesibule. The hall runs across the house, resulting in a somewhat unusual layout of rooms on the ground floor, dividing the ground floor into two sections, with living room and sunroom at the front and dining room and kitchen at rear. No undesirable features are introduced, however, by this arrangement, in fact it has the advantage of completely isolating the kitchen from the living quarters, yet leaving it conveniently accessible. The hall trim is in gumwood with walnut finish and the flooring here, as throughout the entire house is of oak. The living room is a beautiful large room 24 by 15½ ft., trimmed in white-wood, white enamelled, and is equipped with a handsome, dark rug brick fireplace, elaborately trimmed with whitewood and with built-in bookcases on either side. The dining room is finished in gumwood, also white enamelled, and is panelled to a height of about 6 ft. There is a recess, as seen on plan, for a buffet in this room. The kitchen and butler's pantry, which connects the kitchen and dining room, are finished in white enamel and contain the usual built-in cupboard and other service features.

There are three large bedrooms on the second floor, all located off the main hall. In the smaller hall, off the main hall, as seen on plan, are situated bathroom and separate toilet, also entrance to the attic staircase. The bathroom and toilet have tile floors and walls to a height of 4 ft. 6 in. A very handy feature, which is new to the writer, is a built-in linen closet in the bathroom. Throughout the halls and bedrooms on this floor are located many roomy linen closets and wardrobes.



The basement contains furnace room, coal and fruit storage space, toilet and laundry, the latter being equipped with enamelled tubs and entrance from the outside.

The designer of this house is Mr. Ewart G. Wilson, architect, of 42 Langely Avenue, Toronto.



Mainly Constructional

East and West—From Coast to Coast

A by-law authorizing the borrowing of $160,000 for expenditure on public improvements and extension of public works at St. Laurent, P. Q., was passed by the electors recently.

It is doubtful if a start on the new city hall of Kitchener, Ont., will be made this year. The plans have not yet been ratified by the city council.

The corner-stone of the new Jarvis Street Collegiate Institute, at Toronto, was laid a few days ago by Mrs. Harry Cockshutt, wife of the Lieutenant-Governor, and a former pupil of the old school. The new building is in process of erection at the southeast corner of Jarvis and Wellesley streets.

Preliminary construction work has commenced on the erection of plant additions for Ford Motor Company of Canada, at Ford, Ont. The site for the new plant unit has been graded, and preparations have been made for an early start in erecting the building. It is proposed to have the enlarged plant ready for full operations by April of next year. Several hundred men will be engaged in the construction work. The total expenditure will approximate $6,500,000.

A new $100,000 office building will be built by J. J. Coughlan at Vancouver. Plans call for a six-storey structure on Granville St., opposite the Capitol Theatre, with terra cotta base for two storeys and pressed brick above, with terra cotta trim. The plans provide for the addition of four storeys at a later date, which will bring the structure up to the maximum height permitted by the existing building by-law.

The new water reservoir for the city of Sherbrooke, P. Q., has been completed. This huge tank has a capacity of 7,000,000 gallons.

The total amount represented by permits issued at Toronto during the first nine months of the present year is $27,466,591 or $65,000 ahead of the total for the record year of 1912. It is confidently expected that the total for the year will be over $30,000,000.

It has been announced that Sir Clifford Sifton will build a large residence on the south side of the Don Ravine, just outside Toronto, and also two smaller residences for his two sons, the entire construction including the riding school and stables, to cost over $200,000. The main residence will be of the Tudor period type of architecture, of three storeys and basement, and will contain 30 rooms in all. The smaller residences will each contain about 21 rooms, according to present plans. All buildings will be of solid brick with stone trim. The grounds, which includes about 30 acres, cost $200,000 and the landscape gardening, water, light and other services will bring the entire cost of the project over half a million dollars.

A special Legislature committee in public session at the provincial parliament buildings, Toronto, recently, discussed the problem of the regulation of the province's waterways and the conditions under which rights connected with them should be granted. No tangible decision was reached as a result of the meeting, but the assurance was given by Hon. Beniah Bowman, chairman of the committee, that the water rights bill would be altered in respect to the clause which refused to grant concessions outright. The exact form and the extent which the alteration will take will be more definitely determined after the committee holds a session in the near future at Port Arthur, and hears there the opinion of the lumber men in the north-west section of the province.

The new gravel road in Quebec province from Megantic to Springhill, thence to Stornaway village, where it connects with the Montreal to Quebec highway, has been opened for traffic.

The Grimsby Brick and Terra Cotta Company, of Grimsby, Ont., announce that they are rebuilding their plant which was burnt out recently.

Personal

F. E. Brown & Son, general contractors of Toronto, have moved their offices from 60 Westmount Avenue to 20 Watford Avenue.

Mr. A. H. French, of Pittsburgh, general manager of the Jefferson Highway Association, was a visitor in Winnipeg recently, being on an inspection tour of the Jefferson highway route.

Hon. F. C. Biggs officiated at the opening of the new bridge over the Thames river at Richmond St., London, Ont., recently.

Mr. E. L. Cousins, chief engineer of the Harbor Board, at Toronto, is reported as considering resigning from the Board for the purpose of entering private practice as a consulting engineer. It is possible, reads the report, that the Board will retain Mr. Cousins' services in a consulting capacity only, which would allow him to also devote his time to private practice.

Mr. Fred V. Siebert, of the Dominion Survey Branch, Ottawa, has returned from a summer in the North Country. He has spent the season in doing exploration work through a large tract of practically unknown country west of the Slave River, at the extreme top of Alberta and beyond.

Obituary

Mr. Alan Timbrell, resident engineer of the Provincial Highways Department at Simcoe, Ont., died recently in that town in his 47th year, from pneumonia. Deceased was born in England and had resided in Simcoe for about a year, previous to which he was located at Ottawa. He was a member of the Engineering Institute of Canada.

Trade Incorporations

F. Henderson & Son, Ltd., with head office at Lachine P. Q., capital $49,000, to carry on a general contracting and engineering business.

J. B. Caine Co. Ltd., with head office at Montreal, to, carry on a general contracting business and to distribute first and second mortgage bonds arising out of construction projects. Among the incorporators are Messrs. J. B. Caine, Harry D. Bayne and H. K. Ferguson. Mr. Caine who has been associated with P. Lyall & Sons Construction Company for several years as vice-president and treasurer, will be president and general manager of the new firm; Mr. Bayne, who has been connected with the Westinghouse Electric Company and the Canadian General Electric Company for several years, will be secretary and director, and Mr. Ferguson, was with Messrs. Ross & MacDonald, well-known firm of Montreal architects, for over 12 years and has been in charge of such works as the Toronto union station, the Chateau Laurier and the Grand Trunk station at Ottawa. The temporary office of the company is in the New Birks Building.

The Carmichael Waterproofing Co., 918 Palmerston Ave., Toronto has been reorganized under the name of A. W. Carmichael, Ltd., with capital of $250,000.

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada,
reaching Architects, Engineers, Contractors
Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director

HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL - 119 Board of Trade Bldg.
WINNIPEG - 302 Travellers' Bldg.
VANCOUVER - Winch Building
NEW YORK - 296 Broadway
CHICAGO - 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U. S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 **Toronto, October 18, 1922** **No. 42**

A Code of Ethics for the Engineer

Engineering bodies for many years back have discussed at great length and at frequent intervals the possibility of developing a code of ethics that will govern the practice of the profession and the conduct of its members. Such codes in a more or less complete form have been part of the constitution of most professional organizations, but their observance has been somewhat a matter of individual concern. In these days, perhaps, more attention than ever before is being given to the status of the engineering profession and to the possibility of enforcing a code of ethics. In this our own national engineering organization—the Engineering Institute of Canada—has not been behind the lead and, indeed, the council of the Institute has appointed a committee to report on the proposed code recently published by a committee consisting of representatives from the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Society of Heating and Ventilating Engineers. The ten clauses as this proposed code of ethics will bear repetition here:

That the dignity of their chosen profession may be maintained, it is the duty of all engineers to conduct themselves according to the principles of the following code of ethics:

1. The engineer will carry on his professional work in a spirit of fairness to employees and contractors, fidelity to clients and employers, loyalty to his country and devotion to high ideals of courtesy and personal honour.

2. He will refrain from associating himself with or allowing the use of his name by an enterprise of questionable character.

3. He will advertise only in a dignified manner being careful to avoid misleading statements.

4. He will regard as confidential any information obtained by him as to the business affairs and technical methods of processes of a client or employer.

5. He will inform a client or employer of any business connections, interests or affiliations which might influence his judgment or impair the disinterested quality of his services.

6. He will refrain from using any improper or questionable methods of soliciting professional work and will decline to pay or to accept commissions for securing such work.

7. He will accept compensation, financial or otherwise, for a particular service, from one source only, except with the full knowledge and consent of all interested parties.

8. He will not use unfair means to win professional advancement or to injure the chances of another engineer to secure and hold employment.

9. He will co-operate in upbuilding the engineering profession by exchanging general information and experience with his fellow engineers and students of engineering and also by contributing to work of engineering societies, schools of applied science and the technical press.

10. He will interest himself in the public welfare in behalf of which he will be ready to apply his special knowledge. skill and training for the use and benefit of mankind.

In commenting on this code in his presidential address before the Toronto branch of the E.I.C. last week, Mr. Storrie, the branch chairman stated that we had a duty to perform to the public as well as the public having a duty to perform towards us. "We must honestly and fearlessly show up and endeavor to stamp out everything in the profession that savors of wrong doing," he said. "Ability and reputation should be the means of securing our individual progress rather than the amount of wire-pulling and so-called influence that is so often brought to bear on the securing of appointments." To substantiate this statement Mr. Storrie cited a number of instances of unethical practice in which the engineering profession, or at least individual members of the profession were shown in a bad light. In one case, for example the influence of contractors who had received contracts from a firm of engineers was widely used to secure a certain appointment. Under such circumstances how could this firm be fair and just in their dealings with these contractors? This form of securing the influence of contractors who have received contracts from engineers is a serious affair and one that should not be employed under any conditions. In another case one alderman absolutely committed himself to a contractor to vote for a certain engineering firm before he even knew who were being considered for the appointment, or before the committee investigating the status of the various engineers had brought in a recommendation. Needless to say, this contractor had in the past received several contracts from the engineering firm for whom he was working. In yet another case, the manager of a contracting company approached one of his shareholders, asking him to do his utmost to have the rival firm withdraw its application in order to ensure the continuance of certain contracts that it had been accustomed to receive from the engineer-

No. 85

Canada's Engineers—J. F. Fafard

Mr. J. Fernard Fafard was born at L'Islet, Que., in 1882. He received his first school training as a lad attending the school of his parish and later the Lewis College where he graduated a bachelor in 1901. Upon leaving college Mr. Fafard served his probationary course in the Western Provinces assisting in surveys of parts of Northern Saskatchewan and Alberta during the years 1902 to 1907, after which period he returned to Quebec where he successfully passed his examination as land surveyor for the province. Since 1907 Mr. Fafard has been contracting for himself. He was the first to survey the then wild region of Lake Abitibi, and has explored for the Quebec Government large areas north of Lake St. John. He has also done extensive survey and exploration work in the Upper St. Maurice for the Brown Corporation, timber limit proprietors. In 1917 Mr. Fafard entered politics and was elected member for the Constituency of L'Islet for the House of Commons, being re-elected in 1921. Mr. Fafard is a director of the Corporation of Land Surveyors of the Province of Quebec.

Mr. J. Fernard Fafard

ing firm they were anxious should secure the appoinment. Apart from other considerations this means of securing certain work is an absolutely unfair situation in which to place any contractor and strenuous means should be taken to overcome such unprofessional conduct.

Mr. Storrie's comments on this kind of conduct are such that nothing further need be said. "One can readily understand," he states "that if this condition of affairs is allowed to continue considerable damage to the profession and loss of prestige will result. The sooner the public realize that when tactics like those mentioned have to be adopted in order to secure work there must be something seriously wrong with the engineering ability of the firm that finds it necessary to adopt them, the better it will be for the engineers as a whole. If we wish to be seriously considered by the public as a profession, let us see to it that we adopt professional conduct in our business affairs. Fortunately for the profession we have as a whole a fine body of men but that is all the greater reason for jealously guarding our interests and exposing the few who would seek to lower our ideals. We must purge the profession of that kind of work and set our own houses in order and above reproach before we can expect that recognition from the public to which we are justly entitled and before legislation, minimum fees or ethics can be of any avail. Let us jealously guard our ideals and show an ever increasing factor of moral safety and courage in our dealings with the public and our fellow engineers."

Toronto E. I. C. Program

On October 19 Mr. S. R. Cound, general manager of the Baldwin Steel Corporation, will give an illustrated lecture entitled: "Informal Talk on the Manufacture of Tin Plates and Plant Operation," before the Toronto branch of the Engineering Institute of Canada. On October 26 a discussion will be led by Mr. Norman D. Wilson on town planning legislation. Both meetings will be held at the Engineers' Club, 90 King Street West, at 8:15 p.m.

Cannington, Ont., Is Planning Waterworks

The Council of Cannington, Ont., have engaged James, Proctor & Redfern, consulting engineers of Toronto to prepare plans and submit estimates for the construction of a waterworks system within the municipality. The plant will consist of mains, standpipe, electric equipment and a turbine driven pump.

Changes in Windsor, Ont., Architectural Firm

Announcement is made that B. Buller Colthurst, of the architectural firm of Nichols, Sheppard & Colthurst, 15 Sandwich St. W., Windsor, Ont., has withdrawn from the existing partnership, and will in future practise by himself at 32 Sandwich St. W., Windsor. The present firm under the name of Nichols & Sheppard, will continue to practise as usual at the old address.

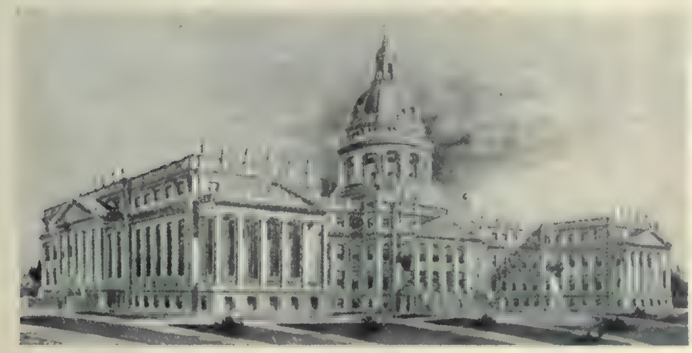
Handsome Building for Ottawa University

New Wing Is Nearing Completion—Part of a Scheme of Reconstruction of a Building Destroyed by Fire Several Years Ago—Details of Design and Construction

The progress on the reconstruction of the main building of the Ottawa University which was destroyed by fire some years ago, is advancing quite rapidly in spite of the limited means at the disposal of the authorities of the university. A new addition to the central part of the already completed building will soon be ready for occupation, and will contain study halls, dining rooms, private rooms and dormitories. The new wing has the following dimensions; length 90 ft., width 53 ft., and a total height of 100 ft., comprising five stories and basement.

The foundations are of concrete resting on hard pan, and comprise two superimposed footings, the lower one of which measures 4 ft. in width by 1 ft. 6 in. in height, and the upper one 3 ft. by 1 ft. 6 in. These footings support a 2 foot concrete wall extending up to the ground line a distance of 10 feet. The basement walls and cellar floor are made water proof by means of a special composition called "Impervite" mixed with cement and aggregate.

The exterior walls are made of Indiana limestone of which 575 tons were used, besides one and a quarter tons of building stone for the base. All exterior walls are lined with 3 in. by 12 in. terra cotta, and all partitions are made of gypsum blocks of different thickness.



The new Arts building of the University of Ottawa as it will be when completed

A 1-2-4 mixture was used for reinforced concrete throughout the building, the crushed stone being 5/8-inch in diameter. All steel used as reinforcement is of the "Truscon System." The ceilings of the entire building are made according to the type known as "Floretyle Flat Ceiling Construction Standard," supplied by The Trussed Concrete Steel Co., of Canada Ltd.

All floors are of terrazzo finish. The exterior woodwork and all frame work are made of first quality of white pine; and the interior woodwork finished with red pine. All windows of the exterior walls are made with English sashes 2¼ in. thick. The slate used for the stairs is one and one quarter inch thick for the treads and three quarters inch for the risers,—about 820 tons of crushed stone were used in the work.

A view of the exterior under construction

The style of architecture of the building is pure classical Greek,, monolithic columns with Ionic Capitals. The dome will be adorned with figures of the apostles and surmounted by a cross, while the parapets will be ornamented with statues of Canada's great men.

The architect who designed the original plans of the building is Mr. A. O. Von Herbulis, of Washington and New York, but Messrs. Viau and Venne, architects of Montreal, are in charge of the detailed design and construction of the section of the building now under way. The contractors are John Quinlan & Co., of Montreal and Ottawa.

The concrete frame

Engineer's Relation to Public Health

Water Supply and Sewage Disposal Are the Fields in Which the Engineering Profession Aids Most Effectively in Improving Health Conditions—Over-Economy Has Dangerous Possibilities

By WM. STORRIE

of Gore, Nasmith and Storrie, Consulting Engineers, Toronto and Chairman of the Toronto Branch, E.I.C.

An excerpt from an address before the Toronto branch of the Engineering Institute of Canada

Let me make some reference to "The Engineer and Public Health." Practically every piece of engineering has an effect on the health of the people. This effect is of a varied nature reaching its maximum in that branch of engineering dealing with water supply and sewage disposal and it is these two phases to which I propose to refer.

All New York State Board of Health Bulletins have this statement prominently displayed: "Public Health is Purchasable; Within Natural Limitations Any Community Can Determine Its Own Death Rate." This statement sums up to a nicety the situation on all public health matters. The life and death of the citizens is an economic problem depending almost entirely on two essentials,—Education and Expenditure of Money. It has been well said that education respecting health matters is the light that will eventually lead us out of the unsanitary wilderness.

Danger of Over-Economizing

We hear a great deal these days about economy. It is the cry of the present day and there can be no doubt but that the financial situation of the country demands economy. War, industrial strife, and strikes are waste and everything possible should be done to stop this waste. But this cry of economy opens up a possibility of great danger by delaying restoration, reconstruction and progress. Economy must be prevented from becoming merely a popular cry. It must be borne in mind that the mere stoppage of expenditure of money may not be economy but may result in real waste. It is not economy to refrain from the expenditure of money that will ensure to all the people an abundant supply of pure, wholesome water protected not only by the purification of the water but by the efficient treatment of the sewage. There is no expenditure of public funds that brings such excellent results as that spent on improving the health of the citizens. It can be most clearly shown by considering some of the leading cities of Ontario that there is a very close relation between the death rate and the amount of money spent by the public health department.

Year	Amount Spent per capita	Typhoid Fever death rate per 100,000	Remarks
1905	$0.24	17.2	
1906	.24½	27.6	
1907	.25	21.3	
1908	.27	20.9	
1909	.27¼	24.7	
1910	.27¼	44.2	Chlorination starts
1911	.41	21.6	
1912	.45	13.2	Slow sand filters start
1913	.53	11.4	
1914	.59	8.1	
1915	.64	1.9	Pasteurization of milk starts
1916	.67	6.9	
1917	.83	3.8	Drifting sand filters start
1918	.90	3.1	
1919	1.25	2.6	
1920	1.72	2.3	
1921	1.58	3.1	

Toronto's Typhoid Death Rate

The case of the City of Toronto where the water supply is both filtered and chlorinated is particularly interesting as will be seen from the table at the foot of the previous column.

Ontario's Typhoid Death Rate

The cleaning up of the water supplies of the Province of Ontario has been gradual and its effect is plainly shown in the following table relating to the typhoid death rate per hundred thousand of population in the different types of community in the province:

Year	Counties	Cities (excluding Toronto)	Toronto	Towns	Average for Province
1921			3.1		
1920	6.2	5.5	2.3	25.0	7.0
1919	4.6	4.3	2.6	19.5	5.2
1918	5.1	9.6	3.1	17.2	7.5
1917	6.6	7.5	3.8	31.4	8.4
1916	8.1	12.1	6.9	52.2	12.5
1915	9.4	9.4	1.9	38.0	10.7
1914	10.0	12.4	8.1	47.4	13.5
1913	13.3	17.3	11.4	46.0	17.7
1912	10.9	27.7	13.2	47.0	18.7
1911	16.1	35.8	21.6	62.3	25.3
1910	22.0	51.5	44.2	56.4	31.5
1909	25.1	34.3	24.7	67.7	29.9
1908	20.5	37.8	20.9	107.1	29.7

It is interesting to note that in every case where cities have a much lower typhoid rate than towns it is due unquestionably to the more complete control of the water and milk supplies and to a greater degree of completeness of the sewerage and sewage disposal systems. The table shows that so far as the towns are concerned they are considerably behind the cities in the typhoid death rate showing the necessity in the towns of having improved water and milk supplies. The City of Toronto previous to 1910 took its water supply from Lake Ontario without treatment of any kind. Following a mild typhoid epidemic in 1910 the raw water was chlorinated. In 1912 a slow sand water purification plant was put into use so that for that year the raw water was partly filtered and chlorinated. In 1917 the drifting sand water purification plant was put into operation while in 1915 the city passed a by-law enforcing the pasteurization of the milk supply. The following table gives Toronto's typhoid mortality rate per hundred thousand of population:

1910—44.2
1911—21.6
1912—13.2
1913—11.4
1914—8.1
1915—1.9
1916—6.9
1917—3.8
1918—3.1
1919—2.6
1920—2.3
1921—3.1

This has been accomplished notwithstanding the fact that during the last ten years the pollution of the raw water has increased enormously. Thus in 1910 before the water was treated in any way the typhoid mortality rate was 44.2 per hundred thousand of population while in 1921 the rate had decreased to 3.1 per hundred thousand, a very striking result due to a large extent to the efficiency of filtration and sterilization of the water supply. To put it in another way,—if the same typhoid death rate had taken place last year as occurred in 1910 here would have been approximately 220 deaths whereas there were only 16. The following table shows the death rate from typhoid fever compared with the expenditure of the public health departments:

Place	Year	Typhoid death rate per 100,000	Amount spent per head on public health
Province of Ontario	1919	5.2	$ .20
City of Toronto	1919	2.6	1.25
Cities other than Toronto	1919	5.6	.70
Towns	1919	19.5	.70

Other Engineering Fields Affecting Health Standards

While the most effective work of the engineer in relation to public health has undoubtedly been connected with water supply and sewage disposal, other fields have contributed towards the betterment of the health of the community. I need only mention the great work done by irrigation and drainage in relation to malarial fever, particularly in reference to the work done on the Panama Canal. There are other forms of engineering work that are rapidly coming to the front, particularly in reference to sanitation and industry. It has been clearly shown the tremendous effect of dust removal in the reduction of tuberculosis in certain classes of industry. The controlling of the air supply in industry by the conditioning of the moisture and temperature have had wonderful effects in relation to fatigue and output of the workers. Better lighting systems have been introduced thus preventing many accidents due to bad lighting and fatigue. Wonderful progress has been made in general ventilation and with all these problems the engineer has been very closely connected.

I have endeavored to show what this branch of engineering has been able to do for the health of the citizens particularly in this neighborhood. It is unnecessary to dwell at any length on the part played by the engineer in securing this increasingly satisfactory state of affairs as to one and all it is self-evident that to a very large extent the engineering profession is responsible for arriving at the methods, the design, the construction and operation of the systems that have attained the desired results. The remuneration of an engineer for the carrying out of this work is of two kinds,—the actual monetary consideration received and the satisfaction which must accrue to him from the successful carrying out of any form of engineering work affecting the health of the citizens. The responsibility placed on the engineer is a heavy one and he must make absolutely sure of his ground before proceeding with the work. Most engineering is visible and any mistakes that may be made are open to the public view. In this respect we are unlike the medical profession where most of their mistakes are under ground.

It is only necessary to make a close study of the tables and statistics available to realize what tremendous advances have been made in sanitary engineering. In the City of Toronto we know beyond all doubt what improved water and milk supplies have done towards reducing typhoid fever. That can be definitely ascertained from the figures available but that does not end the effectiveness arising out of these improved conditions. There is no doubt whatever but that the general health of the whole community is benefited but the precise amount of benefit derived cannot be ascertained from the statistics.

While such great improvements have taken place particularly in the sciences of water supply and sewage disposal I firmly believe that we have yet a great deal to learn particularly in reference to sewage disposal. A study of the history of water purification indicates improved conditions being arrived at step by step so that now a filthy, dangerous water may be made clear, sparkling and sterile in 15 minutes; and while greater advances have been made in the purification of water than in the satisfactory disposal of sewage there still remains a wide field for research work in connection with our water supplies.

A much more difficult problem is the satisfactory disposal of sewage and particularly of the sewage sludge and I believe we are on the verge of great developments along these lines. The satisfactory disposal of sewage in most communities is essential if for no other reason than the protection of other municipal water supplies. The unsatisfactory nature of many sewage disposal plants erected in the past has frequently developed into a nuisance as well as a source of pollution of water supplies. While large expenditures in the past have taken place in protecting our water supplies, many municipalities in this province are faced with heavy expenditures on sewage disposal. During the last ten years a great deal of research and experimental work in sewage disposal has been carried on. There still remains the problem of the satisfactory disposal of sludge to be solved but there is every indication that this is in a fair way towards solution. While the present generation is busily engaged cleaning up the water supplies and sewage disposal I believe the chief sanitary problem for the coming generation to solve will be connected with the purification of the air. With a tremendous hydro-electric development in this part of the world this is unlikely to be such a burning question, but where many municipalities are dependent largely on coal as their source of power then this matter becomes urgent and every effort towards its solution will very materially react on the health of the community. The increased use of electric power will go a long way towards improving the purity of the atmosphere.

An Efficient Concrete Plant Layout

Description of Model Concrete Mixing and Placing Equipment to Illustrate the Requirements of an Efficient Design—What Such an Installation Saves

By **RICHARD P. WALLIS**

In "The Constructor"

The success or failure of a construction operation depends in no small manner upon the layout and equipment of its concreting plant. By the concreting plant is meant the mechanical equipment for receiving, storing, mixing and depositing the materials that constitute the concrete frame of the building.

The objects sought in providing these devices as a substitute for human labor in the carrying on of these operations are to increase the speed and to reduce the unit cost of preparing and placing this concrete. These requirements constitute the criterion by which performance of the plant is judged.

As practically each building operation is unique in its character, so may we expect to find separate and distinct problems to solve in meeting individual job requirements. There are, however, two fundamental principles that are common to all efficient plant layouts. In the first place, the continuity of supply must be guaranteed against interruption so as not to jeopardize the successful placing of the concrete; furthermore, the force of gravity should be employed wherever possible to convey material from one location to another.

Factors Influencing Selection

The special factors that influence the selection of equipment are as follows: 1st, the nature of the material to be handled; 2nd, the source of supply and method of transportation; 3rd, local physical conditions; and 4th, the initial cost and probable salvage value of such equipment.

The equipment decided upon must be well adapted to the purpose for which it is intended. Cement in bulk requires one type of conveyance, while in sacks it must be handled by other means.

The source of supply and method of transportation exercises a considerable influence in the choice of this equipment. If the aggregates are obtained from local sand and gravel banks, special washing and screening apparatus will be required as well as excavating equipment. If brought to the site by water, rail or truck, unloading devices must be provided that will function in a satisfactory manner in each case.

The arrangement of the buildings, their height, the quantity and distribution of the concrete to be placed, and the amount of available storage space must be considered before deciding on any particular layout. Existing rail or dock facilities must be investigated as well as the topographical features of the site. The plant layout must be shaped to profit by any special physical condition that may exist at the start of operation.

The initial cost and probable salvage value of equipment should be considered before determining on the final layout. Equipment may be selected that will expedite the work of manufacturing concrete yet,, owing to its prohibitive cost, increase the unit cost to such a point as to wholly nullify its usefulness in that respect. The salvage value of equipment of this character is variable and depends upon the original cost of the equipment and on the care received by it during the operation.

Don't Overequip

Over-equipping a plant is as unfortunate in its consequences as is failure to provide sufficient equipment to fully utilize the existing advantage. Additional plant should be installed only when it is clear that such addition will satisfy the criterion of speed and cost.

The final layout should be determined upon only

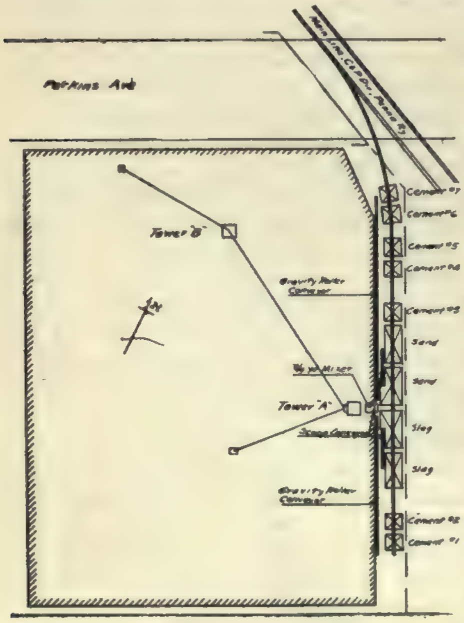


Fig. 1

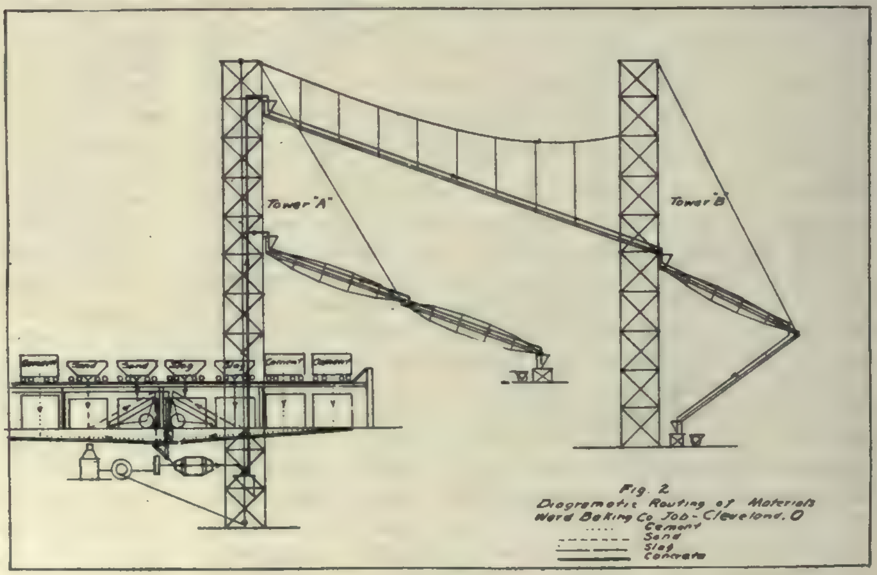


Fig. 2

after a careful consideration of all these factors. The plant should be well balanced throughout—that is, all parts should be selected so as to function in an efficient manner without loss of time or materials. A basic principle of engineering construction is to make no one part better or stronger than the rest. This same principle applies to the selection and arrangement of concrete plant equipment.

A Model Plant Layout

The plant layout in the new building now under construction by the Lundorff-Bicknell Co. for the Ward Baking Co., at 46th Street and Perkins Ave., Cleveland, contains numerous interesting features and admirably illustrates the application of many of the above principles to a typical plant layout.

The building itself covers an area of 260 feet by 315 feet and varies in height from 20 to 60 feet. The floors of this building are of reinforced concrete, designed as flat slabs averaging 7 inches in thickness and carried on heavy concrete columns. Altogether, including floor, columns, foundation, etc., there are approximately 10,000 cubic yards of concrete in the finished structure.

The building is located in a built up district of the city and occupies approximately 70 per cent. of the entire lot. This limitation of available storage space necessitated a careful preliminary study of the possibilities offered by the use of mechanical equipment in the efficient handling and placing of this concrete.

Fortunately there existed at the start of operation an 18 foot wood trestle along the entire east side of the property carrying a single track spur from the main line of the C. & P. Division of the Pennsylvania Railway. The entire plant was planned and erected with especial reference to the use of this track in the delivery of materials.

Sand, slag, stone and sacked cement are brought to the job in car load lots. The bottom-dump cars are spotted on the trestle over the respective bins and sheds and their contents unloaded by gravity. The aggregates are dumped through the hoppers to their respective bins, while the cement is dropped directly down through chutes to the various sheds below.

Power for shifting these cars locally by means of a cable and nigger head located at one end of the trestle is obtained from the same 75-h.p. McMyler boiler that operates mixer, hoist and pumps.

Storage

As will be noted from Figure 1 there are two sand bins, each with a capacity of 150 cubic yards and two slag bins of similar capacity. It was found necessary to build twin bins for both sand and slag owing to lack of sufficient height beneath the trestle bin with a storage capacity for a day's continuous pouring. This arrangement was made possible by the use of two power-driven Jeffrey belt conveyors that elevate the material from the outer bin in each case to that adjacent to the charging hopper. These conveyers are operated by 5-h.p. electric motors and have a lifting capacity of approximately one cubic yard per minute.

There are seven cement sheds with an average capacity of 950 sacks (one car load) each. Sheds No. 1 to No. 6 inclusive are for daily use, while shed No. 7 is held as a reserve in case the unexpected happens and the supply of cement is interrupted. Car load lots of cement are not used until after the report of the seven-day test has been received. Until then a sign bearing on one side the words "Do not use" is placed on the door of the shed containing that particular car load. Upon approval this is reversed to read "O. K." and the cement is ready for use.

Mixing

The material from the inner bins is admitted directly to the charging hopper of the mixer, which is located in a pit directly between and below these bins, through steel cut-off gates operated by hand. This charging hopper is divided into two portions by a vertical partition so that the proper amount of sand and slag for each batch is easily determined by filling each portion to the proper level. The cement is brought to the charging hopper from the various sheds by Mathews gravity roller conveyers. Wood pallets with a capacity of 3 sacks each (enough for one batch) are provided for this purpose. The empty sacks are shaken, counted and tied in bundles of 50 each, and are stored near the cement sheds for ultimate return to the mill.

Water is supplied from city mains and is measured by means of a tilting barrel conveniently located on the mixing platform. The flow of water is controlled by means of a quick acting value located at the barrel. The charging hopper when filled with the proper charge of material for the batch, discharges into a 3/4-yard Smith tilting mixer, operated by an Orr and Sembrower 10-h.p. vertical engine geared direct to the mixer and supplied with steam from the main boiler, where it is properly mixed.

Distribution

The batch is discharged into the hoist bucket and elevated in the main tower "A" a distance of approximately 150 feet to a receiving hopper. A 10 inch by 10-inch single-drum McMyler mine hoist is used for hoisting the concrete. This main tower has a second receiving hopper located part way to the top which, as the work progresses, may be raised by means of a winch located at the tower base. This latter hopper discharges into a floor hopper through a 100-foot section of Lakewood trussed steel chute, jointed in the centre and supported from the tower by steel cables, which is used to deposit concrete to the area immediately adjacent to the mixer. The concrete from the top hopper is spouted to a second receiving hopper in tower "B," some 155 feet distant, by means of a line chute with a fall of 4 inches to the foot, supported by block and tackle from a steel cable strung between the two towers. It is then distributed to the various locations by means of an adjustable section of chute 100 feet long, jointed in the centre and supported by cables from the top of tower "B." Lakewood chutes are used throughout in this equipment; these are semi-circular in section and have a radius of 7½ inches. Swivel joints and splash hoods are provided where necessary to insure the flexibility of the operation and to prevent loss of materials.

The towers are of wood, 9 feet square and are built of 6-inch by 6-inch posts, 2-inch by 10-inch ledgers and 2-inch by 8-inch cross braces, all securely spiked together in 7-foot bents and well guyed.

Daily Plant Capacity 350 Cubic Yards

As the specifications state that all concrete must be placed by hand, floor hoppers supported on platforms are provided at the end of each chute for loading the concrete into buggies. The layout calls for a maximum distance of 150 feet that concrete must be buggied.

This plant is designed with the idea of mixing and placing a maximum of 350 cubic yards of concrete per eight-hour day. To supply the necessary amount of material for this quantity of concrete there are required about 195 cubic yards of sand and 300 cubic yards of slag. This is the approximate capacity of the combined bins, so it is necessary to restock the bins at least once a day during the interval of continuous pouring. The cement sheds have a total capacity sufficient for from four to five days' continuous run at maximum capacity. The railroad company makes two switches a day, which is sufficient to keep the bins well stocked at all times.

Provision is made for preheating the sand and slag during freezing weather by means of steam coils inserted in the bins and supplied by the same boiler that furnishes steam to the hoisting engine and mixer.

Costs

It is estimated that through the use of this plant equipment the cost of stocking sand and slag has been reduced to approximately 3 cents and 4 cents per cubic yard, respectively, and that cement is handled for approximately 7 cents per barrel. Handling, mixing and placing costs for this concrete is in the neighborhood of 90 cents per cubic yard. This cost is somewhat higher than it would be were it possible to spout the concrete directly into the forms.

Five laborers are used to operate this plant back of the mixer, one tending the water, one each at the sand and slag shut off gates, and two handling the cement. Two engineers are required, one at the mixer and one on the hoist. There is also one laborer in the pit to keep it clean, while another is stationed in each tower during pouring to regulate the flow of concrete through the hoppers and chutes.

The use of this equipment does away with an additional force of 15 laborers behind the mixers, who would otherwise be engaged in handling the concrete materials. This means a saving of $90 a day for an equivalent of 40 days' continuous pouring, or a total of $3,600. As the total cost of the equipment exclusive of possible salvage is in the neighborhood of $10,000, this saving alone represents 36 per cent. of the equipment cost. This saving is equivalent to 36 cents a cubic yard of concrete. The cost of this equipment per cubic yard of concrete is approximately $1.00.

Requirements of Concrete Highways

What Must be Done to Safeguard the Heavy Investment Already Involved in Hard Surfaced Roads—Recommendations Regarding Subgrades and Slabs

Synopsis of an address by Col. H. C. Boyden before the Winnipeg branch of the E.I.C.

There have been built in the United States 262,000,000 square yards of concrete road and 187,000,000 or 71.5% have been built in the last 5 years. In Canada there are 6,000,000 square yards, 54.2% of which have been built in the last 5 years. 52½% of the total yardage in the United States is in 12 states lying north and east of the state of Missouri; this is sufficient evidence that a concrete surface is adaptable to a cold climate. It is impossible to ascertain the cost of all this work but assuming as an average that it was $2.50 per square yard, the total investment in the United States must be $656,000,000 and in Canada $15,000,000. In 1921 $160,000,000 or 24.4% of the total was invested in concrete roads, and it is indicated that the investment in 1922 will amount to $240,000,000.

The salient facts shown by these figures are: (1) the enormous growth in the use of concrete road surface, (2) the satisfaction which such a surface evidently affords, and (3) the enormous investment.

Safeguarding the Investment

The engineer is most interested in the last. The necessity of safeguarding this stupendous investment is obvious, and may be accomplished in two ways—(1) by permanent construction, and (2) by adequate maintenance. While maintenance is essential for any type of road, there can be no doubt that an investment can best be safeguarded by permanent construction in the first instance. It becomes necessary, therefore, in view of the large sums of money which have been and are about to be spent in the construction of roads, to make exhaustive search for the purpose of establishing what is the most permanent type of construction. Heretofore road building has been almost altogether dependent on experience; it has been more of an art than a science. The spriit of scientific inquiry is now, however, aroused amongst road builders and there are at the present time a great many investigations being carried on.

A great many of these investigations are in the nature of observations of the effect of ordinary traffic on certain chosen sections of recently constructed highway. The value of these tests are more from the comparison with other similar tests rather than from any absolute deductions there can be made. Furthermore, since these tests have been carried out at widely separated points and under widely different conditions, just comparisons cannot always be made. The United States Federal Government has recently established an advisory board for the purpose of collecting, collating and co-ordinating the results of all these tests. The most valuable series of tests are those being carried out on specially constructed sections of road under controlled and known traffic.

Col. Boyden stated that he had within the last six weeks visited the scene of operations of every test of importance now under way, citing in particular the Bates test road of the Illinois State Highway Commission and the Arizona Road of the California State Highway Commission. As a result of his observations he made the following recommendations which he divided under three sub-headings.

(1) Subgrades
(2) Concrete slab
(3) Mixing and proportioning concrete.

He mentioned as a matter of interest that the first series of tests on the Bates Road have now been completed and of 72 sections of different types 63 were classed as complete failures; of the remaining 9 eight were concrete slabs and the ninth was a bituminous surface laid on concrete.

The most prolific cause of failure of a concrete road is poor sub-grade. It is found that the resistance of concrete slab to impact is higher the higher the supporting power of the soil. The supporting power of the soil depends on its compactness, its ease of drainage and its moisture content. The higher the moisture content the lower the bearing value, and the moisture content is at a maximum when the ditches are full of water. Therefore the ditches should be designed to carry the water away quickly. The subgrade should be as uniform as it is possible to make it and in gumbo and adobe soils an old earth road surface should be scarified and mixed with sand or cement before laying the concrete slab, this for the purpose of forming sub-grade which lends itself to ease of drainage.

The recommendations regarding sub-grades might be summarized as follows:

(1) Soil studies should be made long in advance of construction.

(2) Every precaution should be taken to insure a uniform sub-grade.

(3) The design of the slab should be varied to suit the bearing power of the soil.

(4) The preparation of a sub-grade ought to be a separate item in the contract.

(5) The ditches should be so designed as to carry the water away quicklv.

(6) A close study of their economies should be undertaken, before deciding to put down tile drains.

(7) Gumbo soil should be pulverized and recompacted for a depth of 18 to 24 inches.

(8) Previous sub-grades should be sealed before laying concrete.

(9) Old roads should be scarified.

Concrete Slabs

It is to be noted that a concrete slab is not a fixture after it is laid. It is subject to movement of various degrees of magnitude as a result of temperature changes, frost action, unequal bearing power of the soil and other causes. One of the most important observations made both at the Pittsburg and Bates test roads was that a concrete slab lifted at the edges at night and at the centre during the day. As a result of this a concrete slab acts as a cantilever at its edges during the night and is very prone to crack when heavy traffic runs along the side during this period. This is prababbly the cause of the longitudinal cracks which are to be observed in the great majority of concrete pavements, and it indicates the necessity of a longitudinal joint in the centre of the slab. It was observed on the Bates Road that a transverse expansion joint is a source of weakness for it creates an edge at right angles to the direction of travel and due to the difference in elevation brought about by edge movement as explained previously the effect of impact is greatly magnified. It would seem advisable to use reinforcing near the edges. On the Bates test road the traffic in one direction was run with the outside wheels 2 ft. 6 in. from the edge of the concrete slabs and in the opposite direction the outside wheels were as close as possible to the outside edge. It was observed that the closer the traffic to the edge the more rapidly failure took place, and this seemed to be independent of the thickness of the slab. It would appear more economical then to increase the pavement width within certain limits rather than to increase the slab thickness. The following is a summary of the chief recommendations appertaining to concrete slabs:—

(1) For one way traffic the minimum width of pavement should not be less than 10 feet; for two lines of traffic 20 feet; for three lines 30 feet, and so on.

(2) In grading, allowance should be made for shoulders not less than five feet wide.

(3) The shoulders should be gravelled.

(4) Concrete surfacing less than six inches thick should not be built under any circumstances.

(5) Concrete surfaces six inches thick should be restricted to traffic not exceeding two tons.

(6) The minimum thickness for any heavier loading should be 8 inches.

(7) Study should be made as to the economy of increasing the width where the sub-grade is poor.

(8) The Arizona section, a 6 inch pavement 9 inches at the sides for a width of 2 ft., seems to offer certain advantages.

(9) Expansion joints should be put in as all changes in alignment and grade at 100 ft. intervals in a reinforced concrete slab and 50 ft. intervals in a plain concrete slab.

(10) All joints should have three quarter inch dowels 6 feet long at not more than 5 ft. intervals, one half of the dowel to be oiled to permit expansion.

(11) A longitudinal centre joint is an advantage but if used should have a 2 inch radius semi-circular key.

(12) Reinforcement does not increase the strength of the concrete slab.

(13) If reinforcement is used it should be at the rate of 60 lbs. per 100 square feet.

(14) Reinforcement should be either in the centre or 2 inches from the top of the slab.

(15) Longitudinal reinforcement consisting of 3½ inch round rods in the centre of the slab should be used on all edges.

(16) Care should be taken to insure a perfectly smooth surface; a ten foot straight edge placed anywhere should show no appreciable deviation.

(17) All joints and cracks which may develop should be carefully inspected and continuously maintained.

Mixing and Proportioning Concrete

The most prolific source of poor concrete is the desire of contractors to speed up the work. While speed is desirable, if it is to result in poor construction it should be sacrificed. It does not appear that it will be possible to efficiently control the speed at which concrete ought to be mixed until a radical change has been made in the design of concrete mixers. The ideal mixer is one on which there is provision for measuring accurately and automatically the ingredients and which once having started to rotate a batch cannot be dumped until the batch is completely mixed. It would appear as a result of recent tests that the strength of concrete increases very rapidly from the time of mixing up to one minute and a half, therefore this is the minimum time any one batch should be mixed. The influence of the amount of water in mixing concrete is now recognized to be of paramount importance and this phase of the subject has been fully tested elsewhere. After the time of mixing and the amount of water the third most important factor in producing good concrete is the method of curing. All concrete road surface, where practicable, should be ponded for a period of three weeks after being poured. If it is not possible to supply sufficient water, the surface should be covered with moist earth for a similar period.

How Does Spray Painting Compare in Cost with Brush Painting?

In the Contract Record of October 4 on pages 965 and 966 appears an article entitled, "How Does Brush Painting Compare with Application of Paint by Spray? Unfortunately, three tables relating to the article were omitted by error and as a consequence, certain conclusions referring to the costs of the operation were valueless. These tables are printed herewith with sufficient explanatory data to enable them to be satisfactorily understood.

The four houses on which the tests were carried out were painted in accordance with the following methods:—

House No. 1. Non-Union, Brush—

Paint brushed by three non-union men. The old paint was badly checked. The men employed on this job worked about as fast as the average good hand brush man would. This job was about as good as House No. 3.

House No. 2, Spray, W. N. Matthews and Brother.—

Old trim was dark red. The body of the house a dirty light drab. A fairly heavy coat of primer was applied with both spray and brush; the primer did not seem to fill the bad spots thoroughly. The surface was not thoroughly wire brushed. Where surface was hard, that is, where paint was not all off surface, a few runs showed.

Table I.—Time and Cost Comparison in Painting Four Houses.
Brush *versus* Spray.

House	Method.	Coats.	Painting Time. 1 Man. hr. min.	Painting Time. 3 Men. hr. min.	Area, sq. ft.	Area per Minute, 3 Men, sq. ft.	Labor Cost at $1.35 per Hour, dollars. Total.	Labor Cost at $1.35 per Hour, dollars. Per Square Foot.	Remarks
No. 1	Brush, 3 Non-Union Men	First	3 55	11 45	1700	2 41	34 08	0 01002	Time cleaning 3 men at 4 hours each = 12 hr.[1] Trimming time included in total time, 4 hr 6 min. Paid contractor for job, $63 25, or $0 0185 per sq. ft. Labor cost 72 hr. at $0 876 per hr.
		Second	4 30	13 30	1700	2 10			
		Total	8 25	25 15	3400				
		Average				2 25			
No. 2	Spray, W. N. Matthews and Bro 3 Men	First	3 18	9 54	1700	2 86	27 85	0 0082	Time cleaning, 3 men, 1 hr each. Total 3 hr.[1]
		Second	3 33	10 39	1700	2 66			
		Total	6 51	20 33	3400				
		Average				2 75			
No. 3	Brush, 3 Union Men	First	2 12	6 36	1700	4 29	17 83	0 00525	Time cleaning, 3 men 1 hr. 10 min each = 3 hr 30 min[1] Trimming included in total time 4 hr 15 min. Paid contractor for job 48 hr. at $1 35 per hr, $64 80, or $0 019 per sq. ft.
		Second	2 15	6 45	1700	4 20			
		Total	4 27	13 21	3100				
		Average				4 24			
No. 4	Spray DeVilbiss, 2 Men			2 Men		2 Men.	16 20	0 00177	One man cleaning 5 hr[1]
		First	3 3	6 6	1700	4 64			
		Second	2 57	5 54	1700	4 80			
		Total	6 0	12 0	3400				
		Average				4 72			

[1] Time cleaning not included in total cost of job or total time.

None of the three workers on the second coat were good brush hands. The spray did not fill in bad spots, especially where the old paint was badly checked or weather beaten.

House No. 3, Union Men, Brush.—

This job was probably the best of the four houses. The work was very good, because the workmen were experts and the house was scraped and sanded and in fair condition for painting. It had a solid coat.

House No. 4, Spray, DeVilbiss Manufacturing Co., Toledo, Ohio.—

Old trim was dark red. A very light priming coat was applied, apparently in many places insufficient to properly seal the surface. The application appeared rather uneven, too light in spots and slightly heavy in others, but with no runs or sags. It took 9 minutes to make connections, erect staging and clean up. It took 30 minutes to do the east side, 29 minutes to do the west side and 44 minutes to do the back. Two men were used on this job. The surface was not cleaned as well as it should be for good painting The first coat was not as dry in places where paint was applied as it should be for re-coating.

Table II.—Quantity of Paint Used, in Gallons, and Area Covered per Gallon, Showing Cost of Material and Labor per Square Foot.

House.	Method.	Paint Used, gal.			Application, sq. ft. per gal	Cost of Paint at $2 50 per Gallon, dollars.	Cost per Square Foot, dollars. Material.	Cost per Square Foot, dollars. Labor.	Cost per Square Foot, dollars. Material and Labor	Total Cost, dollars.
No. 1	Brush 3 Non Union Men	1st Coat	Gray	5						
			White	0 875						
			Total	5 875	289	14 69	0 00864			
		2d Coat	Gray	3 2500						
			White	0 6875						
			Black	0 0630						
			Total	4 0005	425	10 00	0 00588			
		Total, 2 coats		9 8755		24 69				
		Average			344		0 00726	0 01002	0 01728	58 75
No. 2	Spray, W. N. Matthews and Bro., [illegible] Men	1st Coat	Gray	5 125						
			White	0 625						
			Total	5 750	295	14 38	0 00847			
		2d Coat	Gray	4 000						
			White	1 000						
			Black	0 063						
			Total	5 063	336	12 66	0 00744			
		Total, 2 coats		10 813		27 04				
		Average			314		0 00795	0 0082	0 01615	54 91
No. 3	Brush, 3 Union Men	1st Coat	Gray	5 500						
			White	1 125						
			Total	6 625	257	16 56	0.00974			
		2d Coat	Gray	3 750						
			White	1 125						
			Black	0 063						
			Total	4 938	344	12 35	0 00727			
		Total, 2 coats		11 563		28 91				
		Average			294		0 00850	0 00525	0 01375	46 75
No. 4	Spray, DeVilbiss, 2 Men	1st Coat	Gray	4 125						
			White	0 500						
			Total	4 625	368	11 56	0 00680			
		2d Coat	Gray	3 875						
			White	1 000						
			Black	0 063						
			Total	4 938	344	12 35	0 00727			
		Total, 2 coats		9 563		23 91				
		Average			356		0 00703	0 00477	0 01180	40.12

In regard to the cost of doing the work the committee concludes: We believe Tables I and II afford reliable figures as to the cost of paint and labor per square foot between brushing and spraying where the conditions were all unfavorable to the spray method. We believe these figures afford a reliable basis for painting colculations and that they will prove valuable for comparisons in further work. The number of square feet to the gallon of paint consumed on

Table III.—Interior Painting Comparative Test.
Brush *versus* Spray on Cement Finished Plaster in Large Hall at Carnegie, Pa., October 12, 1921.

		Method.	Painting Time. 2 Men, min	Painting Time. 1 Man, min	Area, sq. ft.	Area per Minute, sq. ft. 1 Man	Area per Minute, sq. ft. 2 Men.	Cost per Section at $1.35 per Hour dollars.	Cost per Square Foot, dollars.
Wall Section	No. 1	Brush, 2 Men	17¼	34½	205	5 95	.	0 776	0 00378
	No. 2	Spray, 1 Man, Matthews Outfit		12½	205	16 40	.	0 2812	0 00137
	No. 3	Spray, 1 Man DeVilbiss Outfit		12	205	17 80		0 27	0 00131
Ceiling	2 Men	Spray: 1 Matthews Gun 1 DeVilbiss Gun	135	270	3400	12 59	25 19	6 08	0 00179

Twenty-nine gallon of paint used on 4000 sq. ft. of walls and ceiling, or 138 sq. ft. per gal. of paint. Material cost per sq. ft. at $2.50 per gal., $0 01810. Total, $0 01989.

the four jobs ranging from a maximum of 257 sq. ft. per gallon to a maximum of 425 sq. ft. per gallon, should be noted particularly.

Contrary to our expectations, apparently no more paint was used in spraying than in brushing. The two spray outfits used less paint than the two brush crews, and the finished houses show a difference in appearance in proportion to the paint consumed.

Table III is a summary of tests carried out on cement finished plaster in a large hall.

Standard Tests for Non-Bituminous Road Materials

At the recent meeting of the American Society for Municipal Improvements, the committee on "Standard Tests for Non-Bituminous Materials" submitted a report recommending that the society adopt methods of testing non-bituminous materials which have given useful, satisfactory and reliable results. The report continues: The committee further considers that it is highly desirable that methods of conducting different tests in different laboratories should be as uniform as possible. Hence, it is obvious that, as far as practicable, methods of testing adopted by national organizations should be identical. Based on the above hypotheses, the committee has given careful consideration to the tests adopted by the American Society for Testing Materials, and those proposed by committee C-9 on "Concrete and Concrete Aggregates" and committee D-4 on "Standard Tests for Road and Paving Materials" of the American Society for Testing Materials and by the special committee on "Materials for Road Construction" of the American Society of Civil Engineers.

At the 1921 convention, the society adopted the report of the committee which recommended that seventeen specified tests be tentatively adopted by the society until the 1922 convention. The committee requested in its 1921 report, that criticisms and suggestions relative to the recommended tests be submitted to the chairman prior to July 1, 1922. No criticisms or suggestions have been received by the committee. The committee approves the recommendations, as embodied in the 1922 annual report of committee D-4 on "Standard Tests for Road and Paving Materials" of the American Society for Testing Materials, to substitute two new tests for the following test relative to "Quantity of Clay and Silt in Sand for Highway Construction" and "Workability of Concrete for Cement Concrete Pavements" and hence withdraw these tests and hereafter recommends that the substitute tests be tentatively adopted.

The committee now recommends that the society adopt the following fifteen methods of testing, heretofore mentioned, as standards of the society:

Apparent specific gravity of sand, stone and slag screenings, and other fine non-bituminous highway materials, as described in the Am. Soc. Test. Mat., 1921 Standards, pages 715-718, and designated D 55-19.

Apparent specific gravity of coarse aggregates, as described in the Am. Soc. Test. Mat., 1921 Standards, pages 713, 714, and designated D 30-18.

Mechanical analysis of sand or other fine highway materials, as decribed in the Am. Soc. Test. Mat., 1921 Standards, pages 721, 722, and designated D 7-18.

Mechanical analysis of mixture of sand or other fine material with broken stone or broken slag, as decribed in the Am. Soc. Test. Mat., 1921 Standards, page 724, and designated D 19-16.

Mechanical analysis of broken stone or broken slag, as described in the Am. Soc. Test. Mat., 1921 Standards, page 723, and designated D 18-16.

Abrasion of road material, as described in the Am. Soc. Test. Mat., 1921 Standards, page 710, and designated D 2-08.

Toughness of rock, as described in the Am. Soc. Test. Mat., 1921 Standards, pages 711, 712, and designated D 3-18.

Crushing strength of rock or slag, as described in the Am. Soc. C. E. Trans., Vol. 82, 1918, page 1,442.

Cementation of rock, slag, and gravel powders, as described in the Am. Soc. C. E. Trans., Vol. 82, 1918, pages 1,441, 1,442.

Quantity of clay and silt in gravel for highway construction as described in the Am. Soc. Test. Mat., 1921 Standards, page 719, and designated D 72-21.

Organic impurities in sands for cement concrete, as decribed in the 1921 report, Com. C-9, Am. Soc. Test. Mat., page 12, and designated C 40-21 T.

Tests for portland cement, as described in the Am. Soc. Test. Mat., 1921 Standards, pages 530-547, and designated C 9-21.

Compression test of cement concrete, as described in the 1921 report, Com. C-9, Am. Soc. Test. Mat., pages 6-11, and designated C 39-21 T.

Paving brick rattler test, as described in the Am. Soc. Test. Mat., 1921 Standards, pages 567-574, and designated C 7-15.

Absorption of water by wood blocks after treatment, as described in the Am. Soc. C. E. Trans., Vol. 82, 1918, page 1,447.

The committee recommends that the society tentatively adopt, until the 1923 convention, the following methods of testing:

Decantation test for sand and other fine aggregates, as described in the 1922 annual report of committee D-4, Am. Soc. Test. Mat., and designated D 136-22 T.

Consistency of portland cement concrete for pavements or for pavement base, as described in the 1922 annual report of committee D-4, Am. Soc. Test. Mat., and designated D 138-22 T.

Sampling stone, slag, gravel, sand and stone block for use as highway materials, as described in the Am. Soc. Test. Mat., Proc., Vol. XX, Part I, 1920, pages 789 to 795, and designated D 75-20 T.

Mechanical analysis of sub-grade soils, as described in the 1922 annual report of committee D-4, Am. Soc. Test. Mat., and designated D 137-22 T.

The committee requests that all specification committees and members of the society interested in tests for non-bituminous materials give careful consideration to the tentative methods recommended and submit to the chairman of the committee, prior to July 1, 1923, criticisms and suggestions relative to the proposed methods of testing, in order that the next convention may be in a position to adopt, as standards, the four tentative methods of testing referred to in this report.

The committee believes that the primary function of the special committee on "Standard Tests for Non-Bituminous Materials," is to serve the society as a committee to review new methods and modifications of present methods of testing non-bituminous materials and to recommend to the society, from time to time, the adoption of standards and changes in such standards as may seem desirable.

Is Your Bill of Lading Properly Prepared?

It is a Contract That Demands Great Care in Filling Out—Some Instructions That Will Facilitate the Handling of Goods and Prevent Miscarriage and Unnecessary Charges

If more shippers realized that a bill of lading is a contract, they would use more care in its preparation. Not every statement made on a bill of lading is binding. For example, a shipper cannot demand the use of a rate that he has named and insist, because the carrier accepted the bill of lading, that charges must be figured accordingly. A shipper may not insert a condition or instruct a carrier to perform a service unless that condition or service is permitted or authorized by the tariffs of the carrier. In offering services, carriers are not free agents to contract as they please. They were before legislation became effective, requiring the publication of rate schedules and strict adherence to the rates and rules therein prescribed. Sharp practices, such as rebating, resulted in putting teeth into the law which now allows no latitude but requires the strict, literal and impartial application of tariff rules or rates until they are changed according to a defined procedure requiring, among other things, publicity through the posting of tariffs in stations for a period of 30 days, except in unusual circumstances. The rule is strict that no deviation from the tariff may be permitted. Even though a railroad official may advise that a certain rate will apply, and the shipper may forward his shipment replying on the quotation, he cannot succeed in his demand for the use of the quoted rate if it is not correct, and the carrier must collect the tariff rate even though considerably in excess of that quoted. Tariffs are the most complicated price lists the business man has to cope with, yet the law places upon him the duty of knowing what the rate schedules provide. Ignorance is no excuse for failure to know rates and rules that even the carriers sometimes cannot agree upon in quoting.

Correct Destination Essential

It is obvious, if the consignor states the wrong destination in the bill-of-lading, that he cannot hold the railroad responsible for the additional freight charges caused by the error. When consignors prepare bills of lading they should be careful to insert the correct car initials and numbers, for, if a wrong number is given and if it becomes necessary to reconsign or divert the shipment and the correct numbers are then given in the reconsignment or diverting instructions, the carrier may be unable to carry the instructions into effect and the resulting damage and expense can not be charged to the carrier.

Spell Carefully: Write Plainly

Careful spelling and plain writing are essential. "Alton," Iowa, was written as "Aldon," Iowa. The carrier changed the destination to "Alden," Iowa, and sent the shipment to that point. Later transportation of the shipment to Alton was required. The initial error was the shipper's and the carrier was excused from liability for the additional charges. But, although the initial error was made by the shipper, if the error on the bill of lading is called to the attention of the agent when the shipment is forwarded and he assumes responsibility for its correction, then the shipper is not responsible for damages resulting from the agent's failure to correct the error as he promised.

An Embrasive Bill of Lading

The issuance of a bill of lading to cover each car has resulted many times in needless expense. Tariffs provide for the application of charges on each car covered by a bill of lading where a shipment has been loaded on more than one car and where each car was needlessly billed as a separate shipment and forwarded to a single destination on one day. It is better some times to delay a loaded car until the next day, when the balance of the shipment can be forwarded than to bill the loaded car out under a separate bill of lading.

Conflicting Instructions Must Be Eliminated

Fortunately for shippers, erroneous instructions do not always result to their loss. If the rate is 50 cents, naming 45 cents means nothing and can be disregarded. But if the shipper directs routing "via Columbus" (by way of which a 60-cent rate applies) and then names a rate of 70 cents, which is applicable via Washington Court House, there is a conflict between the instruction to send the shipment via Columbus and the instruction to use the 70-cent rate which applies via Washington Court House. Where each instruction is possible to be complied with, but both can not be observed, the carrier must ask the shipper which instruction should be followed and failure to eliminate the conflict gives the shipper right to recover down to the charge via the cheapest route.

A certain shipment was destined to "Fort Plain," N. Y., according to the bill of lading, with routing specifying West Shore R. R. delivery. Delivery on the West Shore was impossible, because that road did not reach Fort Plain. The shipper intended the shipment should go to "South Fort Plain." It was necessary to reconsign and haul the shipment to "South Fort Plain." The railroad company was required to refund charges in excess of those for transportation direct to South Fort Plain, because of the failure of the agent at point of origin to notice the impossibility of complying with the bill-of-lading instructions and to secure instructions that could be followed.

In one instance, a shipment to "Washington, Ind." was misdirected by shipper to "Washington, D. C." The bill-of-lading, however, contained a routing and a rate which was applicable to "Washington, Ind." The shipment was reforwarded from "Washington, D. C.," to "Washington, Ind.;" but, fortunately for the shipper, he was not required to pay the extra expense because the agent of the initial carrier neglected to call the attention of the shipper to the error and ask which instruction should be observed—the instruction "Washington, D. C." or the rate and routing to "Washington, Ind."

Rates are figured at actual, minimum, or estimated weights. If the actual weight exceeds the minimum, the rate must be ascertained at that weight; but a weight that has been stated on a bill-of-lading cannot be used merely because it has been so stated, unless it is the weight that should be used as specified by the tariffs.—Harry S. Elkins in "The Constructor.'

How the Contractor and the Engineer Can Successfully Co-operate

From an address by Arthur S. Bent, president of the Associated General Contractors of America before the Los Angeles section of the American Society of Civil Engineers

As the representative of many general contractors, it is a red letter event for me to be invited to speak to you, for I take it that you are interested for an hour in getting our point of view on our mutual relations to the great construction industry which is our mutual business, and I heartily welcome this opportunity. Indeed, I think you are extremely civil engineers to accord it to me. Your great society has just completed its three score years and ten, but far from having completed its career, it is even now starting along new avenues of usefulness and honor, and it is typical of the broad and democratic spirit that is now dominating you, that you are glad to hear the spokesman of the men who are the hands for your brains—we who make your dreams come true. Twenty-five years ago our views would not have interested you at all. It is a welcome and hopeful sign that to-day you recognize us as your partners in a great adventure.

Contract Makes Contact Difficult

The contact between the engineer and contractor should always be one of mutual confidence and co-operation but this is made difficult under the common form of contract which at once sets up an abnormal relationship. Their interests do not run altogether parallel. There is a fertile field for mutual irritation and distrust. The contractor, while we may safely credit him with a desire to do a good job, is primarily in the business to make money and he can't help viewing the acts and attitude of the engineer in the light of their effect on profits. The engineer is chiefly concerned with the satisfaction and credit he will get from a first-class piece of work. Usually he is generous enough to hope the contractor will make money, but of course he feels no responsibility about this. In the contractor's heart, born of his experience, there is always the feeling that he will be made the "goat" in many little ways, perhaps in big ones, and that he is pretty sure to suffer some injustices on every contract. In the engineer's heart, on the other hand, is the fear that if the contractor isn't watched he may "scamp" the job, or at least, neglect it. Such a mental attitude as this is obviously a brake on progress and a heavy handicap to the thing we both are trying to do.

I firmly believe that the origin and foundation of this attitude is the form of contract under which we ordinarily work. In its development one party to it has no voice. It is drawn up for the owner. In every line it breathes distrust of the other party. It is full of drastic provisions which indicate complete lack of confidence in the contractor.

The Contractor Must Contract

Did you ever happen to see a contract drawn entirely by the contractor's attorney? I can assure you it makes an interesting document and one that you would never allow your client to sign, yet it only ties up the owner and his engineer exactly as you tie us. Our bankers are always saying to us, "Why did you sign such a contract?" Our attorneys are always asking, "Why didn't you bring that to us before you signed it instead of after you got into trouble?" The answer is obvious. The contractor must contract. He must take what he can get or go out of business. That is his answer, but there is no answer from or for the owner. And I go further and say there is no answer for the engineer if he asks us to make a contract which he himself would not sign and bond.

"Caveat Emptor" Must Go

It is true that the unfair contract is seldom written by the engineer. It is the ingenious deviltry of the owner's attorney, whose sole function is a conscientious and cold-blooded effort to secure every possible advantage for his client. Whatever its source, it is out of joint with the spirit of business to-day. "Caveat emptor" is now a business barbarism. To-day we say, "Live and help live."

Unfair Contract the Stumbling Block

So, if you think with me that the unfair contract is probably the most serious stumbling block in the way of complete co-operation between us, you will welcome the better day that is at hand through the efforts of the Associated General Contractors of America. For more than a year committees from your organization, the Associated General Contractors, the American Institute of Architects, the Railway Engineers Association and the Highway Engineers have been working together earnestly to develop a fair type of universal contract, which when completed, it is hoped, will receive the formal sanction of these bodies and be officially adopted by them. These contracts will cover the fundamentals of the four great divisions of construction—railways, highways, buildings and public works, and it will only be necessary to make them fit local conditions and specifications in each case. Two of these, the building and railways contracts, have already been practically worked out. The ones you are more particularly interested in will no doubt be ready soon; and it is our hope that they will look good to you and have your support toward their adoption by the American Society of Civil Engineers. With the official adoption of these contract forms, I firmly believe that three-fourths of the litigation and half of the friction will disappear.

Engineer's Suggestions Appreciated

In spite of some unfortunate aspects of our contracts, and the disagreements that arise under present systems, able and conscientious engineers have the complete confidence and respect of the contractors. We admire in you the qualities which we know are necessary for success in our own many-sided business—courage, self-sacrifice, patience, persistence and vision. We pay unconscious tribute to the knowledge you have acquired, which passeth even our understanding. We are proud of your friendship when we win it, and like true friends we deplore your one and only class weakness—professional jealousy. We admire your orderly, exact, complete way of doing things, and we try to make our own operations as systematic. We know very well that you can come on to our jobs and see the lost motion, detect the clumsy methods, and tell us where and why we are not making good and we value highly your constructive criticisms and suggestions. We learn much from you.

Temperaments Differ

We are also aware that practically every engineer is sure he would be a better contractor than he ever saw, and we know from much observation that 99 per cent. of you would be dead failures. You can and do put through great projects without contractors. Sometimes you beat our bids (though there is usually an explanation when you do). Often you improve on our methods and equipment. But you do this with the owners' bank account behind you and physical results as your main goal. You are very successfnl as a department of a contracting organization. But almost always, when you step out into the strictly competitive field, as we have to do, get your work by being the low bidder for it and put into it your little ten or twenty thousand dollars that you have accumulated, you come quickly to grief. I have seen many, many such failures and, pondering much over them, have concluded that the answer is one of psychology. I think that which makes a good engineer, the temperament and tastes and abilities which make for his success, cause his failure as a contractor. If he is capable of being a good engineer, he is congenitally unfit to drive a bunch of laborers over onto the right side of the ledger, or to bulldoze nature, or to wrest success with profit from crude and adverse conditions.

An Economic Mistake

I hope this is so, for I believe there is a full field of usefulness for you and also for us. I think it is an economic mistake when engineers try to eliminate the contractor or are unwilling to let him have private work at a fair profit. I think you should never begrudge us good prices. I think you should try to build us up so that you can have our experience and our organizations and our responsibility to depend upon—available when you need them. I am consistent in this, for many temptations have come to my firm to add an engineering department. It would be a very simple thing for us to do and doubtless profitable. But we have always said "no—we think the engineer should not enter our field—we will not enter his."

Proud to be Just Contractors

We are proud, nowadays, to be just contractors, for a new day has dawned on our great industry. One writer's version of the successful contractor is this:

"He must have sufficient imagination to be able to visualize his work completed when it has just started and to bend all things to that end. He must have a sense of humor, so that he may see the funny side of the people he has to deal with, thereby saving himself from nervous prostration; sentiment, to appreciate the dramas and tragedies which daily occur before his eyes; courage, to show the way where there are no battle flags flying or war correspondents to relate his exploits, and to take his medicine in silence when things go wrong; the tact and wisdom and energy of a good executive, and—last but not least—honor, to inspire him to deliver a square deal, when he might easily profit unfairly with no one the wiser."

The Constructor the World's Stabilizer

Upon our industry—the second largest in the world—depends perhaps more than on any other, the stability and safety of this unsettled world. More homes, more cheap power, more highways, more improvements are needed to steady us down and anchor us to the old conservatism and sanity.

Society Needs the Contractor

We contractors believe that our craft is the orderly development of a legitimate function. We are convinced that desirable economic conditions flow from this set up. Society needs the contractor, the man who builds up a great fabric of experience and skill and organization and appliances and holds them ready for responsible public service. The general contractor is needed as a standing army is needed. Doubtless, with a government treasury behind us we can, at great expense, recruit, drill and equip armies and at whatever cost of life and treasure win wars with them, but no nation would accept this method as its main reliance for war if it were sure of constant wars.

Day Labor Versus Contract

If this is true, then your position is unsound when you recommend or undertake construction work with your own forces, particularly public work of importance. If this is right, it is right all the time, and a final analysis finds the Associated General Contractors and the entire construction army, built up by an endless process of specialization and elimination, swept into the discard. Don't you think this would be a disaster to society? Private construction would then inevitably be the victim of hopeless incompetence, now eliminated by the fierce fire of competition. Public work would become the plaything of politics. This is so generally recognized that the people will not vote for great improvement bond issues if they know in advance that their expenditure will be handled by public officials without competition. Do you think Los Angeles, for example, would have voted nine millions for schools if the board of education had intended to build the schoolhouses by day labor? Or the twelve millions of sewer bonds if the city administration had announced that they would build the outfall with their own forces? We know they would not. We all want some guarantees of cost.

Day Labor Costs More

Let me recall the startling contrast between the results of contract work and day labor work by the

State's forces in the construction of the California highways. In the joint report of the two great automobile clubs of California you will find the statement that, of 300 contracts done by the State by day labor amounting to seven millions of dollars, the State's accounts showed unit costs on only five. (How long do you think a contractor would last if he did business that way?) On two of these five the State first called for bids, rejecting them on the recommendation of the engineer, who then went ahead with the work by the State's forces. One of these was in Los Angeles County and the other in Contra Costa County, and the record shows the following figures with the unit prices:

	Estimate	Bid	Cost
1.	$102,000.00	$117,000.00	$160,000.00
2.	43,000.00	64,000.00	81,000.00
Excavating, per cu. ft. ..	0.55	1.10	1.17
Concrete, per cu. yd. ..	4.50	7.50	10.38

In the "Study of California Highways," by the United States Bureau of Public Roads, in an analysis of 20 jobs, 10 of which were done by contract and 10 by the State's forces, the contracted jobs exceeded the engineer's estimate 39 per cent., while the State day labor jobs exceeded the engineer's estimate 193 per cent. Comment on such a showing as this seems superfluous, except to say that it is absolutely typical and could be multiplied indefinitely.

Day of Contractors' Combinations is Over

What arguments are there for not letting work out by contracts? The common one is that the contractors' profit may by combinations be made too high. I want to assure you that general contracting has passed out of the era of combinations, and it is today absolutely impossible to "frame up" an important piece of work. If bidding is genuine competition, is it to be assumed that all of these great construction organizations, carrying their loads of overhead whether working or not, are willing to let these jobs go by unless they can make exorbitant profits? As a matter of fact we cut our costs as low as we dare go, in the hope of landing jobs, and then add from 10 to 15 per cent.

Do you feel as engineers, that there is any obligation on you, or that it is worth your while, to gamble in an effort to save part of the per cent.; and are you justified in believing that, in spite of his lifetime of struggle in the game, you can beat the contractors' costs? You cannot know that bids will be too high until you get them, and you do know how often the opening of bids reveals a gratifying reduction of the engineer's estimate.

A. I. A. Clause Unfair

In the code of ethics of the A. I. A. is a clause which permits an architect to take on the construction of any building for an added fee, but it expressly enjoins him from assuming any responsibility for the financial outcome to the owner. We contractors cannot help feeling that this is not only unfair but that it is highly significant and suggestive. In the construction of a new water supply system of a western city a few years ago, six contracts were let covering a bond issue of about three million. The board felt that some of the bids were too high but finally decided as a matter of policy to let the contracts. Every one of those contractors lost heavily—the total loss being in the neighborhood of a quarter of a million, but every one of them went through without default or delay and the city got its system for its bond issue. Was the contractor in this case an asset or a liability? Such cases could be multiplied without limit.

Public Interest Demands Contractor

In the last California legislature a bill was introduced which provided that State officials were free to do State construction of highways, hospitals and other work with their own forces by day labor if they desired, but in such case they must first call for bids in order to determine what contractors considered the job worth, and then file with the Board of Control the engineer's estimate of what he considered it worth. Then when the job was finished he must file a sworn statement with the county clerk of what it actually did cost. Is there any reason why an honest official would object to giving this evidence to the people of whether their money had been economically spent? If the State highway engineer, who was spending millions on day labor work, was beating the contractors' bids he would, of course, have been proud to show that he was. This bill was passed unanimously by both houses. It was supported by the San Francisco and Los Angeles Chambers of Commerce, by the Merchants and Manufacturers' Association and by many prominent private interests. Nevertheless it was pocket vetoed by the governor without explanation or comment. A similar bill became a law in the State of Minnesota a couple of years ago, with the result that, with the filing of actual costs of work done by official forces, the people are scrutinizing the results and filing their protests against this method and day labor work has been greatly checked. It is not to the public interest to eliminate the contractor.

Creators—Not Gamblers

To summarize: The constructor is the precursor of every form of human activity. He cannot be spared. We, like you, are personal agents. That is the only thing we have to sell. We are creators, not gamblers. The things other men produce remain only materials, commodities, passing through many hands and growing constantly more costly but not more useful, until finally the constructor takes them and transforms them into permanent structures, accomplishes their final destiny of usefulness to man, from which there is no further change. If he fails to do his work well, all that has gone before has failed, too. If he does it well, he is the fruition of a thousand hopes. Is such an agent to be hampered by distrust and injustice? Or should he be upheld, and helped, and encouraged? Should we secretly rejoice when we get the work of his hands for less than it cost him, or should we want him to be well paid for work well done? Should we undermine him and set him aside and find ways to do his work without him, or should we build him up in honorable usefulness and strengthen his character and his hands for this special service to society? As he does his work well or ill, so communities thrive. Failing dams destroy property and life. Poor highways impoverish and discourage States. Shoddy homes breed bolshevism and despair. If then, he does his work well, should we not accord him both honor and reward? There was a day when the honest and skillful constructor stood highest in the social order and it was a good day in history.

Urges Attitude of Trust

Finally, I return to my major topic: "Co-operation." In all the transactions between men, their relations to each other are primarily determined by their attitude of mind and this in turn is largely the resultant of their estimate of each other. If I have before me a business meeting with a shyster lawyer, I approach it with a prejudice and suspicion which at the outset makes it almost impossible for us to work together, even though he might be in a position to serve my interests and be willing to do so. But if I have the same matter in hand with my banker, whom I have long trusted, our minds meet at once and the result is quickly and efficiently reached.

Contracting a Systematized Business

Contracting once was largely a gambling game that encouraged and developed sharp practices; to-day it is a highly systematized business conducted in all its larger activities upon a scientific basis. Once it operated under crude methods with primitive equipment; to-day it succeeds only by the highest efficiency, and is supported by a vast organization of designers and manufacturers who furnish it with highly specialized equipment for its efficient conduct. Once it was led by strong but untrained men, who by force of character or shrewdness had fought their way to the front; to-day its great forces are directed and co-ordinated by men of trained minds, of sterling character and of the highest ideals. The old unfair contract was the natural development of the old condition; to-day it is an obstructive misfit. Engineers are devotees of efficiency; you are its greatest bulwark. But efficiency in construction will always be based upon co-operation between the engineer and contractor. And such co-operation must rest upon a fair contract and upon mutual confidence.

Correction

In our issue of October 4, under the heading of Business Buildings and Industrial Plants, we stated that the general contract for the erection of a furnace building in Hamilton for the Abrasive Co., of Canada had been awarded to W. C. Greenfield. We are advised that this information conveys the wrong impression, inasmuch as there has been no general contract awarded. The steel work, which has been fabricated by the Hamilton Bridge Works Co., comprises we understand, the bulk of the cost of this building, the erection of which is being performed on a day labor basis by Mr. Greenfield.

Report of Quebec Streams Commission

The tenth annual report of the Quebec Streams Commission, which covers the operations of that commission for the year 1921, has just been received. It contains detailed reports of the chief engineer. Mr. O. Lefebvre, on the very varied and extensive operations of the commission throughout the Province of Quebec.

"Structural Problems" by C. R. Young

Students in structural designing and junior designers will find "Structural Problems" by C. R. Young, C.E., associate professor of structural engineering, University of Toronto, of valuable assistance in helping them solve many of the less intricate problems with which they are concerned. This book is a collection of typical problems in the design of steel and timber structures, which are arranged not as a systematic development of the subject, but as an indication merely of the method of applying structural theory to the design of a number of simple structures and members. Since space has not permitted lengthy explanation or derivation of formulas, the book has been fashioned to serve only as a supplement to lectures and standard text books and not in any sense as a treatise. Effort has been made to indicate clearly the peculiar conditions of each individual problem, so that a method of solution will not be used in cases to which it is inapplicable.

The contents are divided into two sections, (1) steel structures and (2) timber structures, under the following chapter headings:—1. True net section of riveted tension members; 2. Light single-angle tension member connected by one leg; 3. Heavy single-angle tension member connected by one leg; 4. Connection for single-angle tension member with lug; 5. Double-channel tension member; 6. Eccentrically loaded steel column; 7. Riveted steel base for H-column; 8. Riveted steel base for channel column; 9. Simple column bracket with stiffeners; 10. Crane runway column bracket; 11. Member subjected to compression and cross bending; 12. Member subjected to tension and cross bending; 13. Stationary jib crane; 14. Purlin subjected to unsymmetrical bending; 15. Design of a steel beam for bending. shear and web buckling; 16. Safe capacity of a beam connection; 17. Design of a steel box girder; 18. Design of a building plate girder; 19. Eccentrically loaded timber column; 20. Modified mill construction interior floor panel; 21. Design of a timber rafter; 22. Timber purlin subjected to unsymmetrical bending; 23. Design of a queen-post trussed beam; 24. Timber bent for a flume trestle; 25. Design of a wooden roof panel.

The book is published by the Engineering Society of the University of Toronto and sells at $2.00 postpaid.

New Electrical Contracting Firm

E. L. Roxborough, Limited, Toronto, Ont., have sent out notices announcing this new firm of electrical contracting engineers as successors to Ramsden and Roxborough. A formidable list of important electrical work is given as evidence of the wide experience of Mr. Roxborough.

Large Electrical Contracts

The Canadian Comstock Company, Limited, Montreal. have been awarded the contract for the electrical work on the million dollar addition to the plant of the Durant Motors of Canada, Limited, at Leaside, Ontario. They are also installing the complete electrical work on the new pulp and paper mill for St. Lawrence Paper Mills, Limited, at Three Rivers, Quebec. This contract includes installation of high and low tension electrical work in sub-station and distribution feeders for power and lighting; it also includes high and low pressure and boiler house steam piping work. Other contracts include the electrical work on the Medical Arts Building, Montreal, for which the Foundation Company, are the general contractors; and electrical work on four cargo boats for George H. Hall, Fraser-Brace and Company, general contractors.

Johns-Manville to Build

Definite assurance has been given that the Canadian Johns-Manville Company will build a manufacturing plant at Asbestos, P. Q. Plans and specifications for two steel and brick buildings, 500 x 150 ft., are complete and it is expected that construction will proceed shortly.

Some Aspects of the Sewage Purification Problem*

By F. W. HARRIS
Corporation Chemist, Glasgow, Scotland

Preliminary tank treatment by sedimentation or chemical precipitation followed by biological filtration is the most widely adopted system for the complete purification of sewage.

The outstanding and most difficult problem in economy of working both contact and percolating filters has been the elimination of "surface ponding," which, in proportion to the superficial area affected reduces the filtering capacity and efficiency of the filters and increases working costs.

The thin, slimy film which covers the surface of mature filtering media consists, for the most part, of disintegrated organic matter containing a teeming population of bacteria and innumerable forms of higher organisms, such as protozoa, worms, &c. Upon this slimy film there is constantly being deposited a product of the purification process—gelatinous organic matter—coagulated from the sewage applied.

Normally this gelatinous matter is ingested and finally oxidised by the organisms, but all too frequently this process appears to be overtaxed and the gelatinous deposit accumulates rapidly. Microscopical examination at this stage shows the presence of additional forms of life. On the microscopical field the disintegrated organic matter now appears to be deposited on the filaments or hyphae of fungal or algal growth. These filaments are so closely interwoven as to form a perfect network, a structure which accounts for the characteristic fibrous texture of the deposit. The extending filaments soon span the interstices of the media, and with the coagulated organic matter deposited thereon a surface impermeable to both water and air is produced causing "surface ponding."

Restoring Filtering Capacity

Periods of rest was the original method adopted to restore the filtering capacity and efficiency. In principle the method is a sound one, water constituting 98 per cent of the obstructing deposit. When air-dried the deposit shrivels up into a mere fraction of its former bulk, but on re-starting the filter it absorbs water and expands. In practice we consequently find resisting periods becoming more frequent, reducing filtering capacity and necessitating the provision of a larger filtering area, thus adding to the capital expenditure and increasing working costs.

These disadvantages are equally applicable to the practice of forking the media, while even the improvement following the more drastic and costly method of removing, washing, screening, and replacing the cleaned media is not permanent.

The importance of a permanent solution of the problem of surface ponding, both on the grounds of increased efficiency and reduction in expenditure, I need not emphasize, and the possibility of maintaining the media of percolating filters in a permanently clean and open condition by the aid of insect life merits careful consideration.

The particular species of insect which has successfully accomplished this work is the Achorutes viaticus, or "water springtails." This small, wingless insect is widely distributed, but, unfortunately, its natural appearance on sewage filters is exceptional.

The practicability of cleaning the filtering media of percolating filters by the aid of Achorutes viaticus was first established at Stratford-on-Avon by Mr. A. Bell, now chemist and manager of the Barnsley sewage works.

During the winter of 1920 one of the percolating filters at Dalmarnock ponded badly. In consequence I decided to investigate whether the character of the Dalmarnock sewage and the nature of the filtering media—whinstone—were suitable for the successful propagation of the Achorutes viaticus. For this purpose I had constructed at the works an experimental filter of 2 cu. ft. capacity, and to provide facilities for studying the habits and activities of the insects I fitted up in the laboratory a large-sized, conical-shaped vessel as an observation filter.

Inoculation of Filters

Both these filters were inoculated during January, 1921, with a supply of media, well seeded with eggs and thoroughly colonized kindly forwarded by Mr. Bell.

My investigation has yielded valuable results, enabling me to overcome many local difficulties and disadvantages, to devise a simplified, improved, and more efficient method of inoculating large filters, and thus facilitate success and extend the applicability of the method.

I have clearly established that successful colonization depends primarily on the thorough acclimatization of the insects to local conditions. The experimental filter fulfils this purpose admirably, and its continuity is ensured by my method of inoculation, which is based upon the fact that the filtrate from completely colonized media invariably contains small-sized insects. The method is equally adaptable either for continuous inoculation or for direct inoculation or badly ponded sections, and provides a method of inoculating such sections with the minimum disturbance to the inoculating media. It is also very economical in the use of colonized media, and renders the simultaneous and continuous inoculation of several filters a possibility. Conditions favorable to colonization are more easily under control, and by the judicious application of suitable pabulum to the surface of the media in the boxes a condition of intensfied colonization can be induced.

Since the adoption of this method in October last marked progress has been made, notwithstanding the decidedly unfavorable local conditions as exemplified in the trades waste character of the sewage, the large-sized, smooth-faced media, and the exposed position of the filters. Five of the percolating filters, representing a superficial area of 1.83 acres and a cubic content of nearly 25,000 yds., have been and are being successfully inoculated in the continuous system. The condition of the media all round the inoculations is now remarkably clean, and the activities of the insects are extending in every direction.

To those who decide to enlist these insects I would utter one word of caution. Do not anticipate an immediate disappearance of ponding. The method is not speedy. Patience and perseverance are required to attain success. Do not be discouraged if after inoculation you lose sight of the insects. They will be working below the surface, cleaning up the accumulation of years. The surest and most easily detected evidence of successful colinization will be found in the masses of white skin casts abundantly distributed throughout well-colonized sections. From the results of my experimental work and practical experience I am convinced that these insects will become an important economic factor in the purification of sewage by percolating filters, and I confidently advise their utilization.

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*From a paper presented to the annual congress of the Incorporated Sanitary Association of Scotland.

The Activated Sludge Process

There is another aspect of the sewage purification problem, one which is attracting increasing attention, to which I should like to refer.

The development of sewage purification on biological lines has invariably tended to intensification of the process, each step forward being marked by a reduction in the area necessary to treat a definite volume of sewage. In this respect the latest development—the activated sludge process—makes a considerable advance; filtration is dispensed with, purification being completed in a single operation.

Activated sludge is ordinary detritus free sludge changed by continuous aeration and agitation with sewage into a flocculent deposit possessing a high bacterial and ciliated protoqoa content, and capable of clarifying and purifying sewage. The essential conditions for the purification of sewage by activated sludge are continuous and intimate contact between the sludge and sewage under strictly aerobic conditions. The efficient fulfilment of these conditions involves the continuous agitation and circulation of large volumes of sewage and sludge, a problem the economic solution of which forms the crux of the process.

Compressed air and mechanical agitation are the two systems at present being operated. The main constructional features of installations on both systems are very similar, comprising preliminary grit chamber, aeration or agitation tank sub-divided by longitudinal walls, so as to ensure long length of travel, and finally, a deep setting tank. The outstanding difference lies in the equipment of the aeration or agitation tank.

On the compressed air system air diffused through a series of porous tiles at a pressure of from 4 to 5 lb. serves the purpose of aeration and supplies the energy for agitation and circulation. On a small scale I have experimented with this system at Shieldhall works for several years, and the efficiency of the purification obtained is illustrated by the tabulated analytical data.

The conclusions drawn from these experiments, extending from November, 1915, to January, 1918, are:—

The maturing and accumulation of activated sludge presented no difficulties at Shieldhall.

The maximum efficiency was obtained when operating with 25 to 30 per cent by volume of activated sludge.

An aeration period of three hours' duration sufficed to completely purify the Shieldhall sewage.

Inhibitory trades effluents produced only a transient disturbing effect.

With the exception of a slight reduction in nitrification, no decrease in efficiency occurred during periods of low winter temperature.

No clogging or other diffuser trouble was experienced.

The activation of sludge by mechanical agitation was introduced by Mr. J. Howarth, chemist and manager of Sheffield sewage works, who, owing to the peculiar character of the trades effluents, had to abandon his experiments with diffused air owing to clogging of the porous tiles with organic growths.

In accordance with the instructions of the Sewage Committee of the Glasgow Corporation, a large-scale experimental unit on this system was constructed at Shieldhall. The agitation tank, 5 ft. deep, is divided into channels 3 ft. 6 in. wide. The total channel length from inlet to outlet is 640 ft., exclusive of the 110 ft. long return channel. The capacity of the tank is 80,000 gallons, and that of the sedimentation tank 26,000 gallons. The agitation and circulation is produced by four paddles, each fitted with four blades, revolving on a central shaft driven by an electric 30-h.p. motor. The aeration of the contents of the tank is brought about by surface contact, and to produce sufficient change of surface to ensure an adequate solution of oxygen a minimum surface velocity of 1 ft. per second must be maintained.

Costs

Regarded from the standpoint of efficiency, the activated sludge process is undoubtedly a success, capable of producing high quality effluents even from refractory trades waste sewages. The economy of the process, particularly the working costs, is a debatable point, capital costs being admittedly lower than for other biological processes. The late city engineer of Worcester, Mr. T. Caink, places running costs of the compressed air system at £2 13s. 4d. per 1,000,000 gallons. This cost of treatment is based on an experience extending from 1906 with a 750,000 gallon continuous flow unit. On the completion of an extension decided on, the entire flow of the city of Worcester will be treated on this system.

The working costs of mechanical agitation have been computed by Mr. Howarth from his experience with a 1,000,000 gallon unit at Sheffield to be £3 10s per 1,000,000 gallons.

That the activated sludge process produces a sludge of high manurial value is beyond controversy. The results recently published of an exhaustive investigation on its fertilising value, a research instituted at the request of the Minister of Agriculture, and carried out on the Rothamsted Experimental Farm, are so conclusive that I will quote the final conclusion of the investigators:—

"These field trials show that activated sludge has a high manurial value in marked contrast with the types of sludges tested at Rothamsted Farm in past years."

The activated sludge process is in reality an intensification of the natural processes of river purification, the river silt being replaced by sludge. The possibilities of future developments lie in several directions. Reduction in working costs may result from either mechanical improvements or acceleration of the biological process. I am very hopeful of considering progress in the latter direction.

One advantage of this process—an advantage not widely recognized—is its elasticity. I have, for example, successfully built up and operated with a modified type of sludge, limited in biological activity, but producing rapidly well-clarified, purified, non-nitrated effluents. This fact is in itself suggestive of wide possibilities in the adaptability of the process to comply with varying local conditions. Again a still further increase in the manurial value of the sludge is within the range of probability. The compactness of the process, its efficiency and the possibilities of future developments deserve careful consideration by those contemplating designing new or extending existing works. That the sewage is maintained throughout under acrobic conditions and the total absence of sewage flies make this process very suitable for isolated public institutions, such as sanatoria, &c.

Is Open or Closed Shop Cheaper?

A Few Illustrations of Jobs Handled by Both Methods to Show How Costs Compared

By **LEONARD C. WASON**

President, Aberthaw Construction Co., Boston

I wish to give just a few words on details and of personal reasons for preferring to execute work on the open shop basis.

There are enough men following the company year in and year out to form the nucleus of the hand-working force. They set the pace, educate and tone up the strangers whom we hire as needed. There is greater loyalty obtained from all, and we can control our work. The job superintendent can plan ahead, give his orders and be sure he can carry them out without outside interference from a walking delegate. We do not pay the price of skilled labor for unskilled work. This eliminates waste. We have no restriction of output. There are no jurisdictional disputes. We can change men from one task to another. If a man is a carpenter, painter and glazer, we can very nearly keep him busy the whole year round.

The estimating department can predict with certainty the costs months ahead, thus we do not get stuck on contracts. The sales force who obtain work on cost plus fixed fee contracts know what the company can do and guarantee to do. In times of sharp competition like 1921 we can underbid all comers and make or beat our estimates.

I will give a few illustrations of our own work carefully selected so as to be directly comparable—some strictly closed shop, some open.

Brick partition walls on concrete base (8" and 12").

Examples

Masons' pay $1.00 per hour—20 brick per cubic foot.

Job 1149A—In summer of 1919—Approximately 9,000 cu. ft. with closed shop. Cost labor per cu. ft. ...	$0.985
Job 1163A—Mid-winter of 1919—Approximately 13,000 cu. ft. with open shop. Cost labor per cu. ft. ...	0.460

Laying up terra cotta tile partitions

Job 1149A—In 1919—6" and 12" terra cotta, union masons, per cu ft.	$0.534
Job 1177—In 1919—8" terra cotta, non-union masons, per cu. ft.	0.196

Two coat cement plaster on tile

Job 1149A—1,300 sq. yds. of interior work, union plasterers. Cost of labor per sq. yd.	$1.53
Job 177—1,500 sq. yds. of interior work, non-union plasterers. Cost of labor per sq. yd.	0.743

Placing of slab reinforcing steel

Based on average weight per ft. of bars

Job 1150—0.9 lbs. of steel per sq. ft. Union steel setters. Cost labor from store-yard to place in floors per ton	$30.10
Job 1093—0.825 lbs. of steel per sq. ft. Non-union steel workers. Cost labor from store-yard to place in floor per ton	14.36

Making Turbines Noiseless

How an Installation in a Large Hotel was Arranged so as to Avoid Transmission of Undesirable Sound

Many engineers claim that the steam turbine is superior to the reciprocating engine for producing electric power because of its higher fuel economy, smaller size, and lower first cost. But on the other hand, some of the first installations of turbines turned out to be very noisy, so that preference has been usually given to engines under conditions where quiet operation is essential.

The engineers of the new Hotel Ambassador at New York were not satisfied to follow this practice, however, They preferred to use turbines, if it was possible to do so, and felt convinced that if the machines were properly installed, their slight hum could be suppressed. They, therefore, drew up specifications for a thoroughly modern plant for the Ambassador.

The equipment specified consists of three 200 horsepower non-condensing Westinghouse turbines, each of which drives a 200 kilowatt, 250-volt direct-current Westinghouse generator. Special attention was given to the turbine foundations in order to prevent the vibrations of these high-speed machines from being transmitted to the structure of the hotel. The foundations were to consist of a concrete block which was to rest on a two inch bed of sand and was to be separated from the building's foundations by a thick layer of cork on three sides and an open space on the fourth side.

Silencing the Turbines

In spite of these precautions, however, the turbines could be heard in many parts of the hotel as soon as they were started up. Puzzled at this apparent failure of their plans, the engineers made a thorough examination of the installation and soon located the trouble. In pouring the concrete block, the cement had leaked out into the cork and the sand, and had formed a solid mass, thus destroying the sound-absorbing cushion that had been prepared. These defective foundations were therefore torn out and new ones were laid. The rock was levelled, brought to an even surface with cement and the four sides enclosed with 8 in. brick walls up to the floor finish, the whole of which was then waterproofed. A two inch layer of hair felt was placed on the bed, and a two inch layer of compressed cork placed on top of that. Then came another layer of felt and another of cork, and this same insulation was returned up the face of the brick walls to the floor level. The interior surface was again waterproofed with 5 ply membrane felt and pitch, this returned over the top edge of the side wall insulation. Into this insulated waterproof box, a concrete block was carefully poured, which extended over the side wall insulation with brass drip strip cast into the foundation.

This new arrangement solved the problem. Even in the grill room, which is directly above the turbines, not a sound from the engine room can be heard.

Exhaust Steam Used for Heating

Another interesting feature of the Ambassador's power plant is the method used to regulate the steam supply. In order to eliminate boilers, with their smoke, dirt, and trouble, steam is not made on the premises, but is obtained from the New York Steam Company. It comes in at 160 lbs. pressure, passes through the turbines, and is exhausted by them at a pressure of 7 lbs. This exhaust steam is used for heating, making hot water, operating the absorption refrigerating machinery, and for various kitchen and laundry purposes.

The largest part of the demand for steam is, of course, for heating; and if the turbines were operated with the same load all year round, a large amount of steam would necessarily be wasted during the summer months. To avoid this, a supplementary supply of electric power is obtained from the New York Edison Company.

In winter, therefore, two turbines are regularly in use (with the third as a spare), and these supply all the steam and most of the power required. In summer, however, the exhaust from one turbine furnishes all the steam needed, so the other one is shut down, and a larger amount of electric power is drawn from the central station. A special switchboard, built by the Westinghouse Company, permits various combinations of circuits to be supplied by either the turbines or central station, in accordance with the demands for steam. In this way, the most economical ratio of purchased steam to purchased electricity can be constantly maintained.

Investigation of Roofing Materials

H. G. Smith, Dominion Fire Commissioner, Ottawa, has issued a general invitation to all interested parties to be present at a special conference on roofing materials. The conference will be held in Montreal on October 27 and Mr. Smith makes the following announcement:

"In respect to the testing of the comparative fire-resistance of roofing materials, the recently appointed investigating committee composed of Professors H. M. MacKay (chairman), R. DeL. French and F. M. G. Johnson is desirous of meeting the authorized representatives of manufacturers and agents supplying various forms of roofing materials for use in Canada. A conference has been arranged to take place on Friday, October 27th, in the Engineering Building, McGill University, Montreal. The meeting is called for 2.30 in the afternoon and all those having an interest in the matter are cordially invited to attend."

Assist Fire Sufferers

As a contribution to the relief of Northern Ontario conditions, the firm of Frank Barber and Associates, Limited, have offered to the government their services and advice in rehabilitation. This offer submitted through the government, has been accepted by Mayor LeHeup of Haileybury, and Mr. Horace L. Seymour, town planning engineer of the firm, left for Haileybury on Oct 12. While employed on town planning work with the Dominion government, Mr. Seymour was engaged in the replanning of the devasted area of Halifax after the explosion there in 1917. He, therefore, goes with experience that is invaluable in the present circumstances.

The Thomas Register of Manufacturers

The thirteenth annual edition of Thomas Register of American Manufacturers has just been published, being 4,500 pages in size, cloth bound, and while listing only the products and raw materials from United States sources of supply, is used by nearly 700 purchansing agents and buyers for Canadian concerns. The book is divided into three main sections. Over 300,000 makers of 70,000 articles or products are listed in the first section, there being, for example, 2,016 kinds of machinery classified, with the names of the makers of each kind given. There are 99 kinds of acid classified, 285 kinds of brushes, 85 kinds of leather, 119 kinds of pins, 63 kinds of soaps, 242 kinds of valves, 65 kinds of wax, etc. In another section all the manufacturers are listed alphabetically, with addresses of head and branch offices, officers of the company, etc. An exclusive feature is the capital rating showing the size of each concern, giving the reader knowledge whether the firm is a hundred million corporation or a small forty thousand factory with limited capacity. A third section lists 50,000 branded articles with the names and addresses of the makers of these trade named products. There is also a list of exporters and importers, with a directory of banks, commercial organizations and trade publications. The Thomas Publishing Company, New York, is represented in Canada by the Canadian buyers Register Company, 91 Constance Street, Toronto. The price of the book is $17.50 delivered in Canada.

Comparative Statement of Contracts Awarded in Canada

According to Geographical Divisions	Ontario	Quebec	Maritime	Western	Total
September, 1922	$13,984,000	$ 7,238,700	$ 1,234,000	$ 6,856,800	$ 29,313,500
September, 1921	9,153,600	5,792,000	896,900	3,723,200	19,565,700
September, 1920	8,151,300	3,490,000	1,731,300	7,447,500	20,820,100
September, 1919	9,792,300	3,461,000	1,167,900	2,422,700	16,843,900
9 months, 1922	117,587,500	49,179,500	9,154,000	37,726,200	213,647,200
9 months, 1921	85,181,800	48,591,700	7,057,600	44,546,700	185,377,800
9 months, 1920	92,076,900	44,340,700	17,377,600	59,495,100	213,290,300
9 months, 1919	67,120,800	37,656,000	12,656,500	21,371,100	138,804,400

According to Classifications or Types	Residential	Business	Industrial	Engineering	Total
September, 1922	$ 9,534,100	$ 6,275,600	$ 5,170,200	$ 8,333,600	$29,313,500
September, 1921	8,116,800	8,056,500	886,400	2,506,000	19,565,700
September, 1920	4,032,900	6,318,300	2,342,500	8,126,400	20,820,100
September, 1919	4,917,000	5,661,600	3,422,200	2,843,100	16,843,900
9 months, 1922	81,015,800	61,364,700	19,267,700	51,999,000	213,647,200
9 months, 1921	57,451,300	71,417,500	13,252,300	43,256,700	185,377,800
9 months, 1920	45,868,300	74,373,200	55,022,100	38,026,700	213,290,300
9 months, 1919	34,875,600	43,604,600	37,259,900	23,064,300	138,804,400

The Contract Record's

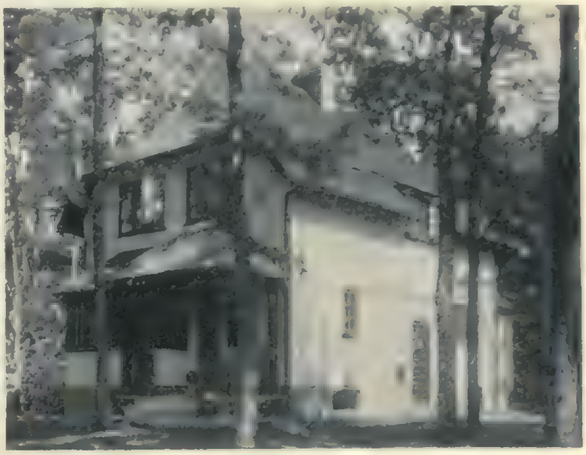
Weekly House Suggestion No. 40

Mr. D. W. Nasmith, of 282 St. Clair Ave. E., is the designer and builder of this moderate-priced, better-class dwelling which is located in the beautiful Moore Park district of Toronto. The exterior construction is made up of brick foundations and smooth finished stucco walls, with rough sawn, stained wood trim on front and rear porches and door and window openings. The windows are all of the French casement type and the roofing is of wooden shingles, stained to match the trim. As will be seen by a glance at the plans, these do not tally with the illustration, but in actual construction the plans were just reversed.

The floor throughout the house is of oak and the trim whitewood, finished walnut on the ground floor, with the exception of the kitchen. The living room is a large, bright room and is equipped with a handsome brick fireplace. This room is connected with the dining room through a wide, open doorway. The dining room also has entrances on kitchen and back verandah. The kitchen is finished in a French gray and is equipped with a built-in refrigerator, iced from the outside, and built-in flour bin and cupboards. A roomy pantry is situated to the rear of the kitchen.

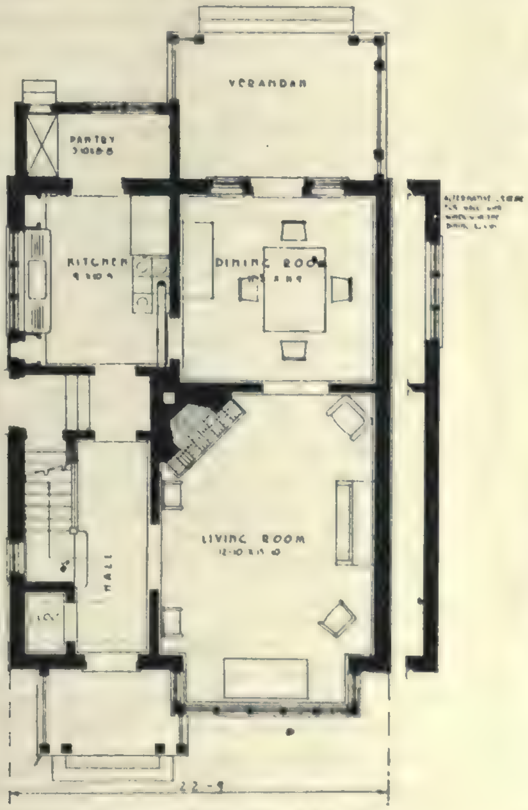
The layout of rooms on the bedroom floor is convenient but not unusual, and includes a sleeping porch over the rear verandah. The bathroom and toilet are combined, the room being finished in white enamel and equipped with built-in shelves for linen.

The basement contains the usual coal, fruit and storage space, also laundry and boiler room.

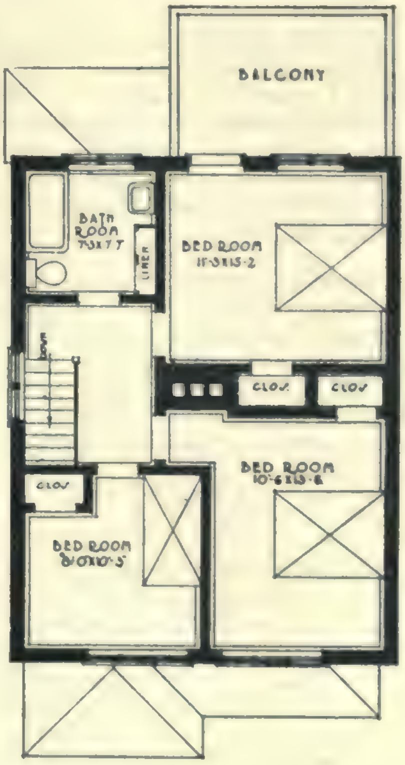


A feature out of the ordinary in this house is the chimney location. By a glance at the plan, it will be seen that it has been carried up through the centre of the house, thus allowing the central location of the fireplace on the ground floor.

There is a garage located at the rear, finished to match the general tone of the house and with driveway direct to the street at the front.



·GROUND·FLOOR·PLAN·



·SECOND·FLOOR·PLAN·

Mainly Constructional

East and West—From Coast to Coast

Mr. George W. Lee, chairman of the T. & N. O. Railway, estimates the total loss sustained in the recent disastrous fires in Northern Ontario at between $7,000,000 and $8,000,000.

The new Galt-Hamilton highway will be opened early next month. Night gangs are now employed hurrying this work to completion.

The Trussed Concrete Steel Co., of Montreal, has received a contract to supply the reinforced steel for the $200,000 school and residence for the Catholic School Commission at Montreal.

The 10-storey building which was rumored for construction some time ago at the corner of Richmond and Sheppard Streets, Toronto, will go ahead. Permit for this building was issued by the City Architect's department recently. The building will cost $400,000.

According to a recent statement, 1,500 homes were destroyed in the Northern Ontario fires. The Fire Relief Committee is supplying free lumber, doors, windows, etc. to each family in the burned area, for the construction of temporary shacks. Mr. A. J. Young, chairman of the committee, estimates that it will cost about $500,000 to provide temporary shelters for these families.

The experimental plant at McMurray, Alta., for the extraction of oil and asphalt from the tar sand deposits of this district, has completed its first year's operation and has been closed down till spring. Mr. Thos. McMurray, one of the officials of the company carrying out these experiments, has expressed himself as satisfied with the results obtained in this year's operation and states they have justified all expectations.

The third annual dinner and election of officers of the Hamilton Chapter of the Ontario Association of Architects was held recently at the Royal Connaught hotel. The following list of new officers resulted; President, Mr. Stewart McPhie; vice-president, Mr. George T. Evans; secretary, Mr. Herbert E. Murton, and treasurer, Mr. William Evans. The executive committee consists of Messrs. W. Souter, F. W. Warren and J. A. Robertson.

The Winnipeg Housing Commission made its annual inspection of the construction work carried out under its jurisdiction this year and has reported unanimous approval of the work. This year's program consisted of the building of 225 homes, some of which are still under construction, representing a financial investment of $855,800. Houses built to date under the commission aggregate $2,287,337 in value, and include bungalow and two-storey homes erected in various designs and constructed of brick, hollow tile, stucco and frame.

The Board of Directors of the Regina Exhibition Association have planned the following program of development for the provincial annual fair and will ask the city to issue 15-year debentures to defray the amount required for the carrying out of this program. The improvements planned are:—Women's and Arts Building, $25,000; Industrial Exhibits Building, $25,000; Sask. Government Building, $25,000; Implement Building Remodelled, $13,000; Sewer and Water Installations, $8,000; Stalls for Horse Barn, $3,000; Band Stand, $1,000; Administration Offices, $4,500; Incinerator, $500; Total, $105,000.

A newspaper report states that a Hamilton man, J. Fleming, has perfected a fireproof paint for shingles. The report of the test carried out at the Central Fire Station, Hamilton, reads as follows: "At the Central Fire Station experiments were carried out with shingles treated with the new compound, and although these were liberally coated with coal oil, the flames refused to spread to the wood, and a charred surface was easily brushed off after the test. Building inspector Whitelock has voiced his commendation of the new paint."

Municipalities throughout Quebec are taking advantage of the grants of 30 per cent. of the total cost of the installation of fire protection systems given by the provincial government, according to Mr. P. J. Jobin, one of the fire inspectors, who returned to Quebec City from a lengthy trip through the province. In the last six months eighteen municipalities have fallen in line and undertaken expenditures ranging from $10,000 to $20,000 to protect their residents. At four municipalities tests are being made, he said, and before many months the protection system will be in operation there also. Those four municipalities are St. Gregoire de Montmorency, Lateriere, Port Alfred and St. Raphael.

Personal

Mr. Harry E. Waterman has announced his retirement as secretary of the Harbor Commission at Hamilton. Mr. Waterman has been connected with the commission in the above capacity for the past 10 years.

Mr. C. L. Moore was recently tendered a banquet and presented with a gold headed cane on the occasion of his retirement from the managership of the Goderich, Ont., branch of the Dominion Road Machinery Company. Mr. Moore had been manager of this branch for about 10 years.

Mr. C. Davis Goodman recently opened an office for the practice of architecture at Suite 34, 14 St. John St., Montreal, and would like to receive manufacturers' catalogs.

Obituary

Mr. James Smith, bridge contractor of St. Thomas, Ont., died in that city recently. Deceased was born in Townsend township, Norfolk County, Ont., 68 years ago and had resided in St. Thomas for the past 30 years. He was connected with the Michigan Central Railway as bridge builder, several of the bridges on the Canadian division having been built under his direction.

Mr. Thomas J. Robitaille, a well-known figure in Eastern Canada construction circles, died a short time ago at the Lake Edward sanitorium. Deceased was born and educated at St. Raymond, Quebec, and later went to Quebec City, where he held the position of superintendent of construction at the Quebec harbor for some time. The latter part of his life had been spent in Montreal, where he had been connected with the William I. Bishop Construction Company, as superintendent of construction.

Trade Incorporations

Les Habitations Royal-Roussilon, Limitee, with head office at Quebec, capital $20,000, to carry on a building business, specializing in workmen's dwellings.

Brown & Forhan, Ltd., capital $40,000 have opened office at 704 Excelsior Life Bldg., Toronto. The company has secured land in North Toronto and intends erecting a number of residences next spring.

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL - 119 Board of Trade Bldg.
WINNIPEG - 302 Travellers' Bldg.
VANCOUVER - Winch Building
NEW YORK - 296 Broadway
CHICAGO - 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U. S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 **Toronto, October 25, 1922** **No. 43**

Construction's Big Problem

A man long in the construction business has written in a recent letter to the Associated General Contractors his personal opinions regarding labor in the industry. His letter which was more or less prompted by a circular he had received from the Research Department of the Brotherhood of Locomotive Firemen and Enginemen, is interesting because it suggests a new plan for the handling of labor.

"This circular," he writes, "is interesting, as being the first intimation I have seen of anybody connected with the Big Four Brotherhood giving a tinker's dam what anybody thought of them. You know and I know what is the matter with the railroads. It is too much specialization, and it is the same trouble that is the matter with the workmen in the building trades. When an engine comes into a round house at night and needs a new steam nozzle, and they have to call out, first, a boiler maker and his helper to open the door and pay him for 8 hours each, even though they do not do another tap of work to complete the job, and they have to call out, under the same conditions, a mechanic and his helper and a pipe fitter and his helper, when the whole job could have been done in an hour or two by a handy man helping himself, we see what a deplorable situation industry is approaching.

"A large Eastern manufacturer recently let a contract to us for a warehouse. Four New York concerns bid on the work, and their bids ran from $150,000 to $160,000. Four Atlanta concerns bid on it. Our low bid was $116,000. From that they ran up to $132,000. The difference between these sets of figures is largely accounted for by having high-priced structural iron workmen put up the steel, high-priced carpenters nailing down flooring and other high-priced artisans doing the things that common labor should largely do.

"I feel that the greatest problem facing construction industry today is the proper handling of labor. This company works union men and it works non-union men and it works them together and it pays a man what he can earn and the good men like it and the bad men don't, as is to be expected.

"Last week I had a call from two of the pillars of the local carpenters' union here who have been on my pay roll for several months past. They stated that they had come to the conclusions that unions, as at present organized, were a mistake, and they asked me to organize a union of my own mechanics and invite a few of the other contractors to join in with their men. Among the objects of the union, they wanted to provide that both employer and employee to be represented in the discussion of problems in which both were vitally interested, that skill and the increase in production be of paramount importance and be recognized in the case of any individual showing unusual skill and ability, and that arrangements be made with some life insurance company which would secure for the men, as a class, the life and death benefits which they now enjoy from other unions.

"I am investigating the possibility of doing something like this; and it seems to me that in some such way lies the solution of our industrial unrest.

"I am giving you these views roughly as they come to me. If we cannot agree on the fundamentals, such as responsibility of both contracting parties, an honest day's work for an honest day's pay, and the measure of a man by his production, we had better give up trying to elevate the industry."

There is no doubt that the whole labor problem is the most serious one. We are primarily interested in the best system to meet modern conditions in the construction industry and to best meet the needs of the future. The best system must be founded on fundamental principles and to evolve those principles necessitates the opinions of those directly involved. Such opinions are invited.

Wages for Out-of-Town Work

If contracting work is done away from the home town of the contractor should the local wage scale prevail or the rates that are current in the city from which the contractor comes? This wage problem, to which the Associated General Contractors of America are drawing attention, is one that demands a settlement that will be a rule for settling similar problems in all cities. In many cases the high scale prevalent in the city from which the contractor comes is insisted upon even though the work in another town is done by the local labor who accepted the local scale in that town.

A case at hand is one wherein a painting sub-contractor sent his foreman from one city with a $1 scale to another with an 85 cent scale. The foreman hired local painters who had been working under this local scale of 85 cents. They demanded $1 per hour,

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Canada's Engineers—G. V. White, C.M.G.

Mr. G. V White

Colonel the Honorable Gerald Verner White, C.B.E., B.Sc., Senator, was born in Pembroke, Ont., on July 6, 1879. He is the son of the late Hon. Peter White, former speaker of the House of Commons for several years.

Senator White received his early education in the public and high schools of Pembroke, later entering McGill University, Montreal, graduating therefrom in 1901 with the degree of B.Sc. in mining engineering. Upon leaving the university, his first occupation was in the service of the Canadian Pacific Ry. going to British Columbia to investigate mining properties there. In 1902 he entered the employ of the Dominion Iron & Steel Co., at Sydney, N. S., where he remained for a year and a half, returning then to Pembroke to become associated with his father in the lumber business. Upon the death of his father in 1906, he entered politics and was elected to the House of Commons succeeding his father. He was re-elected in 1908 and 1911. In the general election of 1917 he was not a candidate being overseas at that time. Colonel White joined the active militia in 1904 and enlisted in November 1915 as Major going overseas in May 1916 as second in command of the 224th Canadian Forestry Battalion. He was promoted to Lieut. Colonel in September of that year and made Colonel in April 1917 and appointed Director of Timber Operations, Canadian Forestry Camps, in June 1917. He returned to Canada in August 1919. In recognition of his distinguished services during the war Colonel White was created a Commander of the British Empire on January 1, 1918. He was appointed to the Senate in 1919 representing the district of Pembroke. Colonel White is a director of the Steel Equipment Co. of Canada as well as a director of other important Canadian corporations. He is a member of the University Club of Montreal and the Delta Upsilon Fraternity.

Senator White was elected president of the Ottawa Valley McGill graduates a year ago and was again chosen this year.

which the foreman refused to pay, and so they struck, tying up the job. In another particular case, to pay the high rate would mean an additional $1,500 on the cost of the job. The same sub-contractor is doing work in two other cities and is paying only the local scale.

If the principle is to pay the local scale regardless of where the contractor's home office is, that is one settlement; if it is to pay the scale prevalent in the home office town, that is another; but if the principle is to pay the highest scale, with no distinction as to whether or not the work is done by local labor of the local town or home town, that is still another method of settlement.

The Canadian Good Roads Association

Mr. Geo. A. McNamee, the secretary of the Canadian Good Roads Association, has written to "The Contract Record" outlining the activities of the organization. His letter follows:

"Our activities since the convention have been addressing various road organizations and municipalities throughout Canada on the subject of roads. The chairman of our executive has just recently returned from the Maritime Provinces, where he addressed several meetings.

"I would say that, summing up the road situation in Canada, the current year has been the most active we have experienced in the matter of actual construction and maintenance.

"We are starting arrangements for the 10th annual convention of our association, which will be held in either Montreal, Ottawa, or Toronto, most likely in the fall of 1923. We find that it will be necessary to start this early in the new year in view of the elaborate plans which our executive have in mind, in connection with this and future conventions.

"We are also endeavoring to have the next World's international roads congress held in this country, following the Seville, Spain, congress, and plans are afoot to this end.

"Further activities for the early part of 1923 will include obtaining the collaboration of each one of the 3,500 municipalities in Canada in the matter of improved roads; the enlisting of a larger active membership; and propaganda dealing with uniform regulations and safety on the highways.

"We are enlarging our office space and staff and on the whole we look forward to an active wind up of the present year, and throughout the whole of 1923."

Concrete Post Caps Double Fire Endurance of Heavy Structural Timbers

Extensive Tests Demonstrate the Effectiveness of Fireproof or Insulated Caps on Timber Columns When Subjected to Fire—A Far-Reaching Effect on Mill Construction

By **THEODORE F. LAIST**
Chicago Representative, National Lumber Manufacturers Association.

The important conclusion reached as a result of a series of tests recently carried on at the Bureau of Underwriters, 207 East Ohio Street, Chicago, may be stated briefly and in general terms as follows:

The fire endurance classification of a nominally 12 inch by 12 inch select structural long leaf Southern pine or Douglas fir column of ordinary length, may be more than doubled if the ends are adequately protected against fire. It appeared from these tests that instead of a thirty-five minute endurance rating, a one and one-quarter hour rating may safely be given providing the steel caps as ordinarily used are insulated or a concrete cap is used, thus preventing the crushing and brooming of the wood fibres under the cap and causing failure long before the sectional area of the column is otherwise reduced to a point of failure. It has, also, been shown that such adequate fire protection for the ends of timber columns in mill construction buildings may be obtained by reinforced concrete post caps such as were used in these laboratory tests. While such caps have been successfully devised for experimental purposes, so far they have not been commercially produced, nor have such tests been made upon caps supporting girder loads.

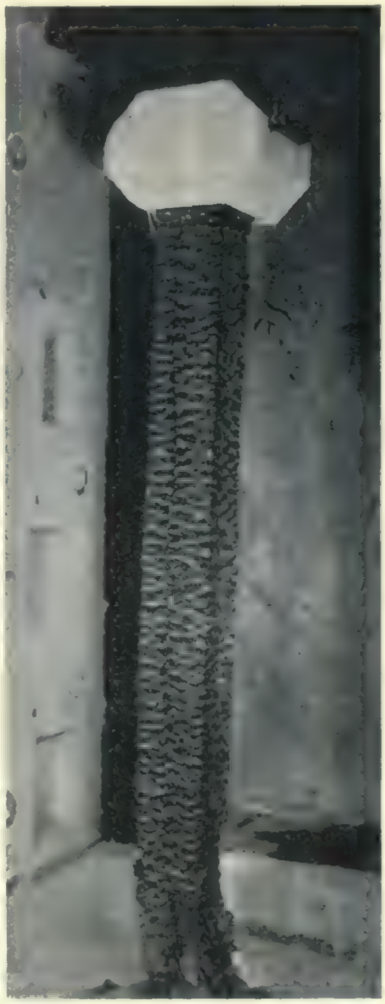
While in this series of tests no experimental work was done with steel or cast-iron caps, it is apparent that consideration of the results obtained would suggest that adequate insulation for the ends of timber columns may be obtained from the installation of fire-proof materials on the exposed faces of standard steel or cast-iron post caps. Other methods of insulating metal caps have so far not been successful for it has been determined, by actual test, that interposing insulating materials of various kinds and thickness between the metal post caps and the ends of the timber columns does not prevent failure of the columns by local end crushing, when loaded and exposed to fire.

These are the important conclusions which may be drawn from the series of tests carried on at the request of the National Lumber Manufacturers' Association. That the knowledge thus gained will have in time a far reaching effect on mill construction is obvious. The way has been pointed out for further investigation in the design of the most commercially practical cap. The concrete cap has solved the problem and there is the alternative of using a protected steel cap. The mechanical difficulties of so insulating the standard metal cap as to achieve the required result should involve no great difficulty. While the concrete caps used in the experimental work did not sustain girder loads, sufficient is known in regard to the design of structural members of concrete and the behavior of reinforced concrete under fire and similar conditions to justify the assertion that no difficulty need be anticipated in this direction. The tests, also, verified the greater superiority in fire-resistance of timber construction to unprotected steel or cast-iron framing.

It may be interesting to follow the history of the development of this work and review briefly the tests which lead up to these investigations.

Previous Tests of Unprotected Columns

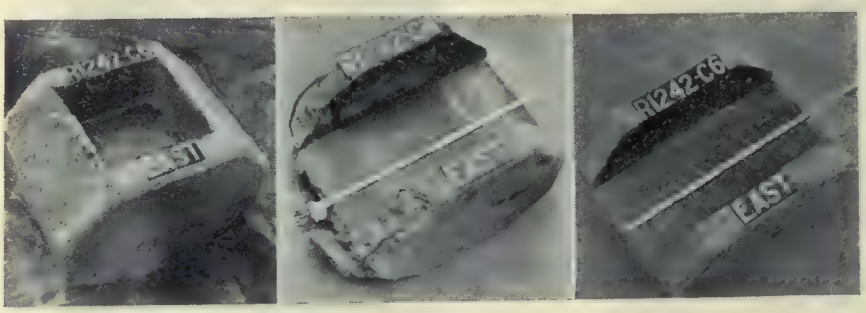
The circumstances which led to the tests and which eventually became the basis for the above stated conclusions, were brought about by observations made during a series of 106 fire tests of loaded columns of various materials, which were carried on during 1917 and 1918 at the Underwriters' Laboratories and con-



Concrete caps considerably lengthened the time during which timber columns withstood fire

ducted jointly by the Associated Factory Fire Insurance Companies, The National Board of Fire Underwriters and the Bureau of Standards*. Among this series were included six tests of timber columns, four of the columns being unprotected, the others being protected by various means. The latter are of no special interest and have no direct connection with the subject of this report. Four of the columns tested at the time were made of long leaf pine and two of Douglas fir. The post caps used were of steel of standard design. The time of failure of the unprotected timber columns varied from thirty-five to fifty minutes. The failures were localized in each case at the bearings with the metal caps, and occurred at the end of the column in contact with the steel or cast-iron caps, through crushing and brooming of the fibres followed by slipping or failure of the cap. Because of such premature failure the full resistance of the columns, under conditions generally assumed in the column formulas, was not obtained. During the test of the unprotected columns, the deformation at the bearing increased rapidly after the first twenty minutes, and at the time of failure was in excess of three inches.

In all cases the action of the steel column cap accelerated the failure of the wooden column. Incidentally it may be stated that it was found that timber columns resist severe fire exposure longer than do unprotected steel columns which has been demonstrated in many fires in buildings.



Concrete post caps after exposure to fire until the failure of the columns. The cracking in the case of the centre cap was not a primary failure but due to the lateral thrust developed by the column at the moment of failure

Plan of Investigation

The object of this investigation, conducted at the request of the National Lumber Manufacturers Association and carried on during 1921, was to study the nature and extent of the deformation accruing at the ends of loaded timber columns in contact with metal post caps, exposed to fire, under conditions similar to those existing in the series mentioned in the previous paragraph.

A further study was made for the purpose of determining the feasibility of preventing local crushing at the ends of the column by interposing, insulating materials between the metal caps and the wood of the columns. This method having been found unsatisfactory, it was determined to substitute a reinforced concrete cap of special design and finally to obtain information regarding the ultimate resistance to fire of loaded timber columns in which failure by local crushing at the ends did not occur.

The reinforced concrete caps used in these laboratory experiments were made by the Underwriters' Laboratories from the design of Mr. S. H. Ingberg, Physicist, Bureau of Standards. To make the construction generally available a patent dedicated to the public was applied for and granted.

Details of the Apparatus Used in the Tests

The equipment used in the tests was the standard equipment, for fire and load tests, of the Underwriters' Laboratory, comprising a carriage and traveling crane for handling the test samples, a furnace, a hydro-pneumatic press for applying load, means for determining deformations and instruments for indicating temperatures.

The combustion chamber is seven feet square by twelve feet high, and for purposes of observation its walls are provided with observation holes glazed with mica. Heat is furnished by means of four gas burners located at the lower corners of the combustion chamber.

The hydro-pneumatic press, used for applying load to the columns, is designed to maintain a constant load during the test and during the failure of the sample. The operating medium is water. The main piston of the press is 36 inches in diameter. The apparatus has a load capacity of 545,000 pounds and has been calibrated by the Bureau of Standards. The accuracy of loading within the range employed in the present series of tests is believed to be within two per cent.

The apparatus for measuring deformation, employed for the tests on wooden columns, was one by means of which the downward motion of the press piston may be indicated during the progress of the test.

For measuring temperatures, four Hoskins thermo-couples, mounted in steel pipe protecting tubes, are inserted in the furnace at various heights above the base. Measurements of temperatures, on the samples, or within the samples, are provided for by means of thermo-couples of such material and location as are adapted for the particular conditions.

Description of Samples†

A description of the samples used in one of the tests will generally apply to all six tests. For three of the tests the columns employed were of dense grade Southern long leaf pine, nominally 12 by 12 inches in cross section and for the remaining three the columns were of Douglas fir. In every case the columns were approximately 10 feet 10 inches long and nominally 12 by 12 inches in cross section.

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*The results of these tests have been published in a report issued in January 1921. "Fire Tests of Building Columns," printed by Underwriters Laboratories, 207 E. Ohio St., Chicago Illinois.

†For the description of the samples and the information used in preparing the condensed report of the results obtained from the series of six tests on wooden columns I am indebted to a preliminary report prepared by Mr. J. B. Finnegan, associate engineer of the Underwriters' Laboratories, under whose immediate charge the tests were conducted.

The Post Cap was one especially devised for this series of tests, and to which reference has been made previously. The reinforcement was made of ¼ inch Havemeyer rods, bent by hand, and welded at all surfaces of contact. The concrete was made of 3 parts (by volume) of cement, 2 parts of Fox River sand and 4 parts of crushed limestone, which passed a ½ inch mesh. The caps were removed from the forms after about seven days and were tested after they were from twenty four days to five months and twenty days old. The weights of the caps varied from 316 to 335 pounds.

Results of Tests

It is not possible, within the scope of this article, to give a detailed description of each sample and the observations made during individual tests but the following general statements may be accepted as applying with sufficient accuracy to all:

The character of the fire at the beginning of all tests was luminous and fairly well distributed, in every case the flames being in contact with all parts of the sample.

The wood members began to char immediately and the contraction of the charred material produced a checkered appearance on all exposed surfaces. In each case vertical checks appeared in the column and during several of the tests the column split vertically along the whole length of the column. The concrete cap was bright red at the conclusion of the test in each case. The edges were in part superficially calcined, the flanges slightly spalled. Hair cracks developed throughout the cap. In only one of the tests, C-4, the concrete cap showed cracking which, however, was not a primary failure of the cap but was due to the lateral thrust developed by the column at the moment of failure, neither did this condition of the cap produce or contribute to the failure of the column.

The line temperature curves showed the average furnace temperature to have been approximately, from 1,800-1,850 degrees, at the time of failure. The average temperature in the concrete cap was in the neighborhood of 300 degrees.

Table Showing Deflection and Time of Failure in the Six Samples Tested

Number of Test	Time in Minutes	Deflection in Inches***	Minutes After Test Started When Failure Occurred	Condition of Cap	Area of Uncharred Wood**
*C-3	45	0.10	84	slightly cracked	41 per cent
C-4	40	0.06	78	cracked, edges spalled	50 per cent
C-5	55	0.03	108	spalled slightly	43 per cent
C-6	50	0.06	98	spalled slightly	44 per cent
C-7	50	0.05	94½	considerable spalling	43 per cent
C-8	55	0.06	112	upper portion of each flange broken	35 per cent

NOTE:

*Colums C-3, C-5, C-8 were of dense grade Southern long leaf pine.

Columns C-4, C-6, C-7 were of Douglas fir.

**Outside of region of failure.

***The term "deflection" is used herein to designate vertical downward movement of the upper end of the assembled sample as indicated by downward travel of the piston of the press mechanism.

The Tin Plate Industry

Described by S. R. Cound at Last Week's Meeting of the Toronto Branch of the Engineering Institute of Canada

At the weekly meeting of the Toronto Branch of the Engineering Institute of Canada, on October 19, the speaker was Mr. S. R. Cound, general manager of Baldwin's Canadian Steel Corporation, Ltd., a branch of the well-known Welsh tin plate manufacturers. Mr. Cound dealt with the history of the manufacture of tin plate and described in some detail the process by which his own firm rolled this product. The manufacture of tin plates was described by Mr. Cound as about one of the oldest industries that existed. "It is not exactly known," he stated, "whether it was introduced in Bohemia or in Saxony, but the time is given as about the year 1230. We generally date the introduction of the industry into Wales, or more properly speaking, the border county of Wales, namely Monmouthshire, as the year 1660. In speaking of tin plates, one should make some explanation. It is obvious to all that the sheet is not entirely a sheet of tin; it is an iron plat coated with tin and it is in this that the secret or the art of manufacturing tin plate, terne plate, lead coated sheets, galvanized sheets, etc., comes in." At this point, Mr. Cound gave a brief description of the manufacture of the iron plate as this process applied from 1660 to 1850. He instanced installations of coated iron plate to show their excellent rust and wear resistant properties.

Mr. S. R. Cound who addressed the Toronto Branch of the Engineering Institute last week

"Does it not seem strange," asked Mr. Cound "that an industry dating back some 250 or 300 years, as far as Wales is concerned, has not had a single text book written about it? There are principles attached to tin manufacture, and they are vital, but they do not form any ground upon which the scientist could commence work. There is nothing to guide the student in the university to first take up this calling; there are no science masters who can instill into you a basis for its manufacture. It is not like engineering, because it is one of the industries which has been built up all along the line from the year 1230 to 1865 on what one may be permitted to call practice. This industry has been handed down and it is to Welshmen alone that we owe its perfection today, and, perhaps, its lack of text books and science.

"As recently as 1888 and 1889, tin plate making was practically unknown in the United States, and the industry was first fostered by the introduction of the McKinley Tariff Bill, which brought about a tariff wall high enough to shut out the Welsh article. There was, however, a low duty on black sheets which accounted for the first introduction of tin plate manufacture on an industrial scale in the United States by Welshmen.

"Many countries have tried to manufacture steel sheets, black plates and tin plates. Germany, for instance, had a rough row to hoe in fostering the industry. I have seen in Germany open furnaces, worked by waste gases from coke oven plants, the whole steaming plant fired by the waste gases from the blast furnace plant. These gases pass through a special cleaning process before being used in the boiler grate and the by-product is sold to reduce the cost of gas. Rolling mills roll down 5, 7 and 8 ton ingots into sections for construction work, ship plating and rails, but when trying to work at black plates for enamelling or tinning purposes, Germany lamentably fell down. France has only two or three works producing tin plate from the raw material.

"I am giving these few facts just to show that while conditions in any part of the world might be ideal, and while these requirements might be the output of 50, 60 or 100 mills, still there is one thing that is an absolute necessity and that is the human element attached to the plant. The workers must have in them the ambition and enthusiasm to be good tradesmen at their various occupations. The plant may be located on the most perfect site, close to a large town or near to where labor may be plentiful; everything socially may be perfect; but if the men employed cannot be stirred up to take a deep interest in their respective jobs, the most perfectly installed plant in the world cannot be operated successfully.

"While in the United States there are plants which have seemingly ideal surroundings, I have not seen there the interest and enthusiasm required in each department that we have in South Wales. Perhaps the secret of the Welsh interest in the industry is the fact that for 250 years whole families have worked from generation to generation in the tin plate business. Each worker has had developed in him a deep, keen love of being a perfect operator and it is this that has helped to make the Welsh tin plate industry what it is today. Wales has quality in its tin plate, but the markets today clamor for cheapness and it is this condition that is fast bringing this wonderful trade of ours to a business of quantity and not quality."

Mr Cound gave a very full description of the plant of the Baldwin Corporation in the Ashbridge's Bay industrial district of Toronto. Reference was made in the "Contract Record" at the time this project was being carried out, of some of the intricate construction problems involved in the erection of the rolling mills. To these Mr. Cound referred, drawing special attention to the masonry foundations that were necessary to carry the load and sustain the heavy pull of the rolling mill. He pointed out how the excavation 25 to 35 ft. deep had to be carried out in the loose fill material and how sheet piling had to be driven. The whole length was then excavated and timbered with piles 30 ft., or so long, each pile being driven almost to destruction of the head, so as to obtain a good solid bottom. All foundations for columns and machinery had to be timber piled and designed to carry the superstructure and to withstand the pull that would be applied to them by the motive power and the rolling mills. The superstructure in connection with the buildings may be made of built-up columns supporting crane runs and roof principles. The sides and ends of these buildings may be enclosed by brick or galvanized sheeting, a great deal depending on climatic conditions.

Reunion of U. of T. Engineering Alumni

Final arrangements have been completed for the fourth annual reunion of the Engineering Alumni Association of the University of Toronto, which will be held Friday and Saturday, October 27 and 28. The program announces class luncheons at noon on October 27 and a dinner dance at the King Edward Hotel, Toronto, in the evening. On the following day the annual meeting of the association will be held in Room 22, Chemistry & Mining Building, at 10 a.m., followed by a buffet luncheon at 12:30 p.m. The Queen's-Varsity football game, at the University of Toronto stadium, will be one of the events of the reunion, while other features will be the faculty reception on the afternoon of the 28th and the annual reunion dinner on the same evening. The principle speaker at the dinner will be Dr. A. C. Humphries, of the Stevens Institute of Technology, Hoboken, N. J., a past president of the American Institute of Consulting Engineers. C. E. Macdonald, 906 Bank of Hamilton Building, Toronto, honorary secretary of the association, will make any arrangements on application and will make proper reservations for any of the events scheduled. The president and board of directors of the Engineers' Club, Toronto, have extended to the Alumni the privileges of the club during the week of the reunion.

Chatham's Street Program

The city engineer of Chatham, Ont., C. H. R. Fuller, reports that the city has practically completed its 1922 road programme which was modified from that originally decided upon on account of the scarcity of gravel. The city is now engaged in constructing sewers on Poplar Street and McDougall Ave., and various water mains, and a large area of sidewalks. Proposed work next year is the construction of asphalt pavements on Colborne Street, Elizabeth Street and Water Street, and concrete pavement on Queen Street South.

Correction

In our issue of October 18, "Constructional Activity" section, we stated that the Corrugated Carton Co., London, Ont., would erect a new factory. This company's name is London Shipping Containers, Ltd., and not the Corrugated Carton Company, as reported.

The John V. Gray Construction Co. Ltd., 541 Queen E. Toronto, have opened an office in Haileybury, Ont., under the management of Mr. J. MacMillan.

Conducting and Paying for Extra Work

A Report of the Standardization Committee of the General Contractors' Association of Cleveland

It has been common experience that the matter of charges and credits for additions to or omissions from plans and specifications for a building project are apt to be a source of controversy between the contractor and owner. Unfortunately it is very seldom the case that a building is put up without some alterations or modifications of the plans, which involve a change in the contract price or the work, and there has been no standard practice in adjusting these differences, so far as we can determine. Therefore, the committee has gone into the problem of trying to determine fair and equitable relations between contractor and owner where such changes are involved, and has formulated certain very definite recommendations.

Alterations or deviations from the original plans and specifications are a source of expense to the contractor, whether the change be in the nature of an omission or in the nature of an addition. All such changes are apt to interfere with the progress of the work, delay the completion of the work as a whole, cause the contractor additional expense on other work in progress on the job which is affected by the changes, and make demands not only on the contractor's field organization but upon his main office organization out of proportion to the amount of work involved. It is evident that there should be a charge to the owner for the services so rendered, regardless of whether the work is an addition or omission.

Recommendations

This leads to our first set of recommendations:

a. That all charges for additional work take into account the contractor's overhead in addition to the actual cost of the work and the contractor's profit.

b. That all omissions take the same items into account, and, to accomplish this end, we recommend that allowances for omissions be based upon the actual estimated cost of the work without any allowances for the contractor's estimated profit on the operation involved—it being our thought that such estimated profit should be retained by the contractor to compensate him for the additional expense involved in deviating from the original plans.

c. Accurate written records should be kept and all transactions relative to changes should be confirmed in writing between the contractor and owner.

Interpreting Plans and Specifications

Where work is considered by the contractor as additional to his contract price, such additional work may arise from a disagreement as to the interpretation of the plans and specifications, or it may be an addition to the plans acknowledged by the owner.

We recommend:

1. That all contractors prohibit their field organization from proceeding with any additional work to the contract, whether acknowledged or not by the owner, without specific instructions from the contractor's main office or his authorized representative.

2. Where the contractor proceeds with work in dispute as to whether or not it is extra, it should be a matter of written record from the contractor to the owner as to the contentions involved and as to the basis on which the work is being done.

3. Where there is no dispute involved, the work should be done on the written authorization of the owner or his agent.

4. An accurate record of all labor and material used in connection with extra work should be kept on a separate extra work report sheet, with provision made thereon for the signature of the duly authorized agent of the owner directing the work to be done, and charged to the owner.

Lump Sum of Time and Material

Where work is performed additional to the contract, it may be handled in two ways. Either on a basis of an agreed lump sum charge or on a basis of time and material plus a percentage for contractor's profit.

We highly recommend that all work which can be intelligently priced and handled on a lump sum basis be so handled, and that the lump sum be agreed upon prior to the execution of the work, with proper acknowledgement of the work and amount involved.

Where it is impossible either through the nature of the work or the element to definitely arrive at a lump sum price we recommend that the work be performed on a time and material basis plus percentage for contractor's profit.

Charges for Extra Work

In the absence of any definite agreement in the contracts, we recommend that charges for extra work performed on a time and material basis be billed to the owner in accordance with the following:

General Items of Cost

The general contractor shall be reimbursed in the manner hereinafter described for such of the actual expenditures in the performance of the work as are included in the following items:

a. Wages of workmen, material, supplies, tools and appliances (as distinguished from machinery and equipment listed hereinafter), and cartage and freight required for the completion of the work in question, either as shown by the revised plans and specifications, or by written instructions, and for the installing, equipping, operating and dismantling of temporary works, plant, machinery and equipment, sheds, offices, commissary and hospital.

b. Sub-contracts placed by owner or general contractor for material or labor or both.

c. Rental, or its equivalent, beginning with shipment and concluding with arrival at return shipping point, at the rates set forth in attached schedule, for the general contractor's machinery and equipment, and rental actually paid by the contractor for other machinery and equipment, or parts thereof, as used in the prosecution of the work, cost of loading, unloading, shipping charges to and from the job, and ordinary repairs and replacements during use and shipment for all machinery and equipment. Rental on machinery and equipment in place at average rental and maintenance charge per schedule assigned by Associated General Contractors or general or main contract.

d. Premiums for bonds and fire insurance, fee of Building Trades Employers' Association, expenditures for telegraph and telephone service, expressage, postage, field office supplies, permits, deposits, royalties, and other similar items incidental to the execution of the contract.

e. Salaries of superintendents, foremen, engineers, timekeepers, clerks, expeditors, watchmen, water-boys, and all other employees in the field office of the general contractor to be pro-rated over the total number of workmen's hours daily and the proper proportion of the superintendent's, timekeeper's, watchmen's, waterboy's, etc., time charged to each item of extra work. If any of these men are giving an overdue amount of their time to any or all items of extra work then their exact time given to the extra work is to be charged.

f. Salary allowances proportionate with time actually applied to this work for employees dividing their time between this and other work, transportation and incidental traveling charges to and from the work for the necessary field forces required in the economical and successful prosecution of the work in the procuring of labor, and in expediting production and transportation of material and equipment, and for other employees or officials of the general contractor actually incurred in connection with this work.

g. Compensation, public liability and contingent insurance on all wages and salaries. We recommend a charge of seven per cent of the payroll to cover these items, together with the uncovered risk.

h. An allowance to compensate the contractor for his overhead expense. We recommend a charge of 10 per cent on the total cost of work to the contractor to cover this item.

Credit to Owner

The owner shall receive from the general contractor the following credits:

1. Rebates to the amount of 50 per cent of the original billed price for all lumber and material used in this work and delivered in good and serviceable condition to and accepted by the general contractor.
2. Rebates to the amount of 50 per cent of the original billed price for all perishable tools and appliances used in the work and upon completion of the contract returned in good and serviceable condition to and accepted by the general contractor.
3. The full returned amount of any refundable deposit made and charged against this work.

To the sum of the items enumerated above, after proper credits have been given, a percentage is to be added for contractor's fee. We recommend a charge of 10 per cent to cover this item.

Payments for extra work should be made monthly on or before the tenth of the month following the month in which the extra work is performed. Extra work invoices should be paid in full, no percentage on same being retained by owner.

What Do Building Costs Embrace?

Do Contractors Always Take All the Factors into Account?—The Builder Is Really a Merchant and Has Selling and Merchandising Expenses

People frequently discuss building costs as if bricks and bricklayers, materials and labor were the only items worthy of consideration. Broadly speaking men and materials do comprise the total expense in construction work, just as they do in any other article produced for civilized man.

What we wish to emphasize, however, is that most people really think that the walls and floors of a building, the visible completed objects, are the only costs that enter into the expense of erection. They think differently, however, when they find it necessary to buy a stick of wood at the lumber-yard or a pair of hinges at a hardware store, which may be needed for an extra partition after they have moved into the new building From their own books business men know just the sort of expense items they must add to the cost for fixed charges, operating expense and legitimate profits. They understand that their selling prices must include rent, taxes and insurance, contingency charges, interest and profits.

Builder Has "Overhead"

The builder is a merchant. He is also a manufacturer, differing from the usual producer in that the builder's factory is portable and frequently without a roof, at least until nearly the end of the job. The builder has a fixed office, a warehouse and yards for storage of machinery and materials. The annual upkeep of these adjuncts must be sustained by field construction executed during the year.

The builder also has selling expense. He must advertise and call upon architects, engineers and owners before he secures a customer. He must pay his estimator to make a quantity survey of the plans, because the owner does not tell him what he tells every body else he buys from—the quantity of material he wants to purchase. The builder's purchasing agent then locates the materials at market prices; and, after careful estimates are made, conferences held and a financier consulted, a contract is made with a future owner and the builder assumes the title and agency of a contract.

As agent, the contractor arranges to incur the following expenses: surety bonds, liability, fire and tornado insurance, building permits, water license, city inspection fee, temporary public utilities service, transportation of materials and drayage of equipment. Not a single item would be visible to a visitor to the building site, and yet they may constitute 10 per cent. to 15 per cent. of the cost. Then there is bank interest, because the owner does not advance money for pay-rolls and material bills. There is also ice and coal, oil, stationery, carfare, postage, rope, perishable tools, scaffolding, demurrage, war taxes and other miscellaneous items which are consumed.

On a job of any size at all, the contractor must provide labor-saving equipment, such as concrete mixers, steam shovels, derricks, hoisting machines, power saws and similar machinery. While they are truly labor-saving and produce economy, they cost about 4 per cent. of their value each month. Then there is the greatest of intangibles, brains, which, mingled with experience, knowledge, good judgment, aptitude and industry, produce that supervision which makes for good results. Brains insure satisfactory service. This is represented in the contractor's organization in many ways. The ablest superintendent, for instance, makes the fewest mistakes, has initiative, plans his work ahead, keeps his men working cheerfully together and gets a quality job done ahead of time within the estimated cost. Such men earn good wages and are worth it. Every merchant and manufacturer knows how scarce leaders are.

Then appear such contingency items as frost, rain, labor strikes, railroad delays and accidents, many of which are common to most industries, but all of which frequently confront the contractor. The law of averages applies the proper charge on such items to the work. Finally, to the actual outlay for materials and labor must be added a remuneration for the contractor sufficient to induce him to remain in business, subject to hardships and risks, and yet keep his financial credit good enough to start the next job.

Do you still think men and materials embrace all building costs?—A. P. Greensfelder in "The Constructor."

Use and Abuse of Systems of Separate Sewers and Storm Drains

By HARRISON P. EDDY

Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

Before the American Society for Municipal Improvements

Separate sewers with few or no storm drains has become common practice in small communities and somewhat prevalent in the larger cities. This has been based, generally, on either real or fancied economic necessity. As it is rather unusual to make complete accurate estimates of cost of the two systems under consideration it may add interest to illustrate the subject by a case in which three plans were designed complete and estimates of cost of all three systems were based upon the lowest bid of contractors upon one of the systems. Estimates of cost of the three projects are given in the accompanying table:

Comparative Estimate of Cost Sewers Under Three Plans

	Cost of Sewers or Sewers and Drains	Cost of House Connections		Total Cost
		Work in Private Property	Work in Streets	
Combined sewers ...	$476,625 (72.7%)	$56,425 8.6%)	$122,600 (18.7)	$655,650 (100%)
Separate sewers and partial system of storm drains	$477,700 (68.7%)	$80,125 (11.6%)	$140,900 (19.7%)	$698,725 (100%)
Separate sewers and complete system of storm drains	$524,850 (67.2%	$90,280 (11.6%)	$164,900 (21.2%)	$780,030 (100%)

The estimates indicate that under the conditions of this case the combined system would be substantially cheaper than the system of separate sewers and a partial or incomplete system of storm drains, and considerably less expensive than the complete systems of separate sewers and storm drains.

Causes of Misuse of Separate Sewers and Storm Drains—The principal causes of the misuse of separate sewers and storm drains may be grouped in six classes as follows:—

1. Ignorance of the purpose and objects of the sewers, due to lack of proper instructions from those designing the systems, or to frequent changes in administration, or to the loss of records and drawings.
2. Indifference of municipal officials.
3. Lack of authority to enforce suitable regulations.
4. Favoritism or "pull" has undoubtedly played an important part in permitting the making of incorrect house connections.
5. Surreptitious connections. In many cases, particularly in times of high cost of construction work, building owners undertake to make certain improvements or repairs directly, or through the employment of journeymen mechanics.
6. In a relatively few instances misuse has undoubtedly been due to incorrect connections made through error.

Great care should be exercised in the selection of the type of sewer system to be installed. It should not be assumed that separate sewers are more advantageous, but conclusion should be reached only after careful study of all the conditions including comparative estimates of cost. In making such studies due weight should be given to the value of the opportunity for disposal of roof water into sewers and to the inequity of affording such facilities to a portion of the property owners and withholding them from others. It may be accepted as a fact that residents will not tolerate standing water in their cellars. In thickly settled communities water cannot be allowed to flow over sidewalks to the street gutters, at least in the northern portion of the country, roofs and areas cannot satisfactorily be drained into gutters by pipes passing under sidewalks. Topography, character of soil, climate, present and prospective density of population, frequency and intensity of precipitation, as well as conditions influencing the problem of sewage disposal, are among the important considerations bearing upon such a selection.

James, Proctor & Redfern, consulting enginters, 36 Toronto St., Toronto, Ont., have been appointed engineers for the township of North York. This is the new township formed north of the city of Toronto out of the township of York.

Preventing Accidents in Contracting*

The Mitigation of Accidents and Elimination of Hazards is Reducing Hardship, Cutting Costs and Improving Industrial Relations—Standardization of Safety Work

By R. C. MARSHALL, Jr.

General Manager, Associated General Contractors of America

Accident prevention, until some twenty years ago, received its principal impetus through laws instigated by employes or students of sociology and often bitterly opposed by management, but since then the situation has radically changed. We find that management itself is stepping far beyond the statutes to provide safe conditions of employment and to conserve the health and lives of workmen. This safety movement is now reducing the frequency of accidents in many lines of production, and is lowering production costs. Its benefits to both employees and management have been proved by actual performance. The success and momentum, which the work has gained, is unquestionably attributable to three good and practical features of accident prevention. These features which have been repeatedly emphasized by whitters and speakers interested in safety work are:

1. Mitigation of suffering and hardship to disabled workmen and their families.
2. Reduction of production costs.
3. The improvement of industrial relations.

The Humanitarian Aspect

The first, humanitarian benefit, requires but a moment's reflection to stir an appreciation of its need and justify the effort to secure it in construction. Constructors are desirous of reducing the physical suffering and poverty caused by accidents in an industry, and any slowness in getting actively behind the move should not be attributed to indifference. If safely work is lagging unduly in the construction field, it is due in great part to the fact that contracting is still, to a great ertent, a one-man business without specialized departments and that the life of the individual heads of small and medium-sized companies is a strenuous existence. The energies have of necessity to be concentrated on the most tangible and pressing problems. The desire to alleviate the suffering is with them as with other humans, but progress will doubtless be slow until the conception of safety work as a concrete and tangible factor is better understood. Having acquired an understanding of the methods of tabulation, study, classification and application of safety measures, constructors both large and small can be counted on to more actively attack the problem.

The humanitarian aspect of accident prevention alone warrants the efforts already devoted to safety work, but it is also supported and justified from the financial standpoint by the saving of safety or, in other words, the lowering of production costs. Actual experience has demonstrated that accident prevention cannot properly be viewed as an added expense, because like the cost accounting system, it not only justifies the expenditure but also more than pays its way.

Safety Saves Money

At the present time and for some years to come the lowering of construction costs is a problem to which construction companies must bend increasing energy. The inverse ratio of construction volume to construction costs is a simple economic axiom, and contractors realize that to maintain the volume they must resist the rising tendency of costs. The poor economic reasoning of simply passing the expense along has been shown up by the manner in which such procedure quickly checks demands, and the wiser course of keeping costs at a minimum now seems to be universally accepted. The problem, therefore, has become one of estimating at a profit without driving out the marginal buyer of new construction, and it means eliminating every unnecessary expense. In doing this the saving of safety work can assist in a number of ways, which may be outlined briefly as follows:

The reduction of accidents by an individual company enables it to obtain from the insurance companies a special rating on experience. This rating means that the company obtaining it pays a premium on its liability insurance that is lower than the standard rate. A representative of one insurance company cited a case where one constructor obtained a reduction of 30 per cent. The accomplishments of the Fred Ley Company which reduced its accident frequency some 85 per cent. in three years, is an instance well-known to those who have followed accident prevention in construction. Another instance was that of a Massachusetts manufacturer who was saving over $100,000 a year on insurance premiums. In construction, where the average premium may run as high as 8 per cent. of the total labor costs and as much as 20 per cent. in specific trades, these economies are assuredly worth an effort.

There is also the item of direct labor-time lost through accidents. Mr. Davison, of Dwight P. Robinson & Company, last year showed where, over a period of some three months, this company had spent about $9,000 in lost time. Where the accident frequency is high, this item assumes significant proportions.

Wages themselves are based to a degree upon the hazard factor, and in general are increased with frequency of accidents on the work. In reality the hazard rate means very little to the workman in the long run, as in case of disablement it is not sufficient to compensate for the disability. This rate stands as an undue expense of the work. A better plan would be to reduce the hazard and eliminate the necessity for excessive hazard wages.

How Accidents Become a Charge

Another wasteful effect of accidents is the indirect loss arising from poor efficiency and morale of the working force when disrupted by serious accidents. Moreover, for every man disabled another must be trained, and the cost of his training stands as a charge against construction. Each such accident represents a more or less distinct increase in labor cost. A reduction of all of these items is not only possible but has been accomplished by individual companies through the application of safety methods.

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*Address delivered at the Eleventh Annual Safety Congress of the National Safety Council,

Reduction of cost and prevention of human welfare are the two most tangible benefits from this work; but the third, a less preceptible one, is of scarcely less importance and probably it is the most urgent: this is the improvement of industrial relations.

Industrial relations of which so many volumes have been written in recent years and which were once considered a subject that had principally to do with educators and social students, is today a real factor affecting every manufacturer and every contractor. Though not a new problem it has in recent years raised many new difficulties in the conduct of construction operations. A glance over industrial history since mediaeval times is sufficient to demonstrate that, as industry expands and as the nation turns more from an agricultural to an industrial country, the complexities of industrial relations increase. Sooner or later these complexities must be ironed out by constructive efforts on the part of both labor and management, and each step that management can take to make the interests of labor and itself coincident constitutes a gain for both.

Co-Operative Spirit Engendered

When employees know that management is exerting an earnest effort to protect them from occupational accident, a more co-operative spirit is certainly engendered. It eliminates in a measure the hardness and soullessness with which modern industry is charged, and makes up in some degree for the personal contact that has been lost. It is questionable whether the blame for antagonism rests solely upon the employees, when we recall that during the last generation those humanitarian measures of safety provision now commonly accepted as reasonable and proper were bitterly opposed by a majority of employers.

Safety work backed by management itself obviates the need of safety statutes which for years afforded practically the only means of instituting safety provisions. It not only accomplishes far more than can ever be required by law, but removes one important obstacle to mutual understanding. Safety work in construction, where the period of employment with individual companies is usually short, is believed to have produced a marked improvement in industrial relation between the employees and those companies who have carried on such work.

In the matter of holding an organization together during a period when labor is scarce, the advantage of safety work become apparent. Those companies that have carried their safety promotion to an effective point undoubtedly find it an asset in holding their men. It is conceivable that the time may come, in construction as in certain manufacturing industries, when workmen will be able to choose between the companies who make their work as safe as possible and those who disregard safety.

If a census of construction campanies were taken to ascertain the attitude concerning safety work, we should doubtless find that it is almost universally approved. Yet a great many companies have not undertaken the work. The difficulty, as already mentioned, is that they are not familiar with the means of carrying on this activity. They need further explanation of the subject and some standard concise procedure for making investigations and interpreting the result. The National Safety Council provides the means through which contractors can learn and apply proper methods of accident prevention, but the standardization of safety work is yet to be carried out for the construction industry. In this work the assistance of every construction campany is merited.

Hydrated Lime in Concrete

Duff A. Abrams, in a Letter to the Editor, Disagrees with Some Published Statements Concerning the Value of Hydrated Lime

Editor, Contract Record:

A paper entitled "Advantages of Hydrated Lime in Paving Concrete," read by T. B. Shertzer before the City Paving Conference in Philadelphia, about a year ago, contains many erroneous statements which should be corrected in the interests of sound engineering practice. As, so far as I am aware, no official proceedings of the conference have been published, I take this liberty of commenting on this paper referred to.

Mr. Shertzer states: "Hydrated lime is the most efficient water tightening medium available. The statement to the effect that it is the most efficient medium has been made by the United States Bureau of Standards as the result of an exhaustive series of tests in which all of the available media were experimented with." The following paragraphs from the Summary of the Bureau of Standards Technologic Paper No. 3 on "Tests of Damp-Proofing and Waterproofing Compounds and Materials," by Wig and Bates, show that the conclusion of the Bureau of Standards is exactly the reverse of that claimed by Mr. Shertzer:

"Portland cement mortar and concrete can be made practically water-tight or impermeable (as defined below) to any hydrostatic head up to 40 feet without the use of any of the so-called "integral" waterproofing materials but in order to obtain such impermeable mortar or concrete considerable care should be exercised in selecting good materials as aggregate and proportioning them in such a manner as to obtain a dense mixture.

"The addition of so-called "integral" waterproofing compounds will not compensate for lean mixtures, nor for poor materials, nor for poor workmanship in the fabrication of the concrete. Since in practice the inert integral compounds (acting simply as void filling material) are added in such small quantities, they have very little or no effect on the permeability of the concrete. If the same care be taken in making the concrete impermeable without the addition of waterproofing materials as is ordinarily taken when waterproofing materials are added, an impermeable concrete can be obtained."

In response to an inquiry of mine, Mr. Bates wrote as follows: "Replying to your letter of August 4, in regard to Mr. Shertzer's statements, I would state that I believe you are correct in assuming that he refers to Technologic Paper No. 3 of this Bureau. However, as a joint author of this paper I may state that I do not believe that we secured any data presented in this paper which would give Mr. Shertzer any reason for making the statements referred to. Furthermore, I do not believe that we drew any conclusions of the nature which he cites. Consequently I cannot understand how he has been able to make the statements that he does in this connection. The Chairman of Committee C-2, American Society for Testing Materials, has brought this to my attention and I have informed him also that as a joint author of this paper I cannot understand how Mr. Shertzer has drawn the conclusions that he has from the data or summary, or any part of that particular paper."

The following suggests an act of legerdemain, which might be entitled, "Water, water, who has the water?"

"The property of absorbing water, for which it has no use chemically, being fully satisfied, reduces the free water content of the entire mass since the water is restrained by the hydrated lime. When the excess water evaporates, it does not leave pores or cavities within the mass of the concrete, since it is present, largely, as envelopes of the particles of hydrated lime, instead as of globules or droplets."

It can be accepted as a fact that if there is an excess of mixing water in concrete it will leave corresponding voids which will in turn lower the load-carrying capacity of the concrete and greatly reduce its resistance to weather and other destructive agencies.

Our tests which go with this subject fully show that the absorption of concrete is not decreased by the addition of hydrated lime. The tests show that the evaporation of water from wet concrete is somewhat retarded by the higher percentages of hydrated lime. (See Fig. 13, Bulletin 8, Structural Materials Research Laboratory. "Effect of Hydrated Lime and Other Powdered Admixtures in Concrete")

The following statement refers to the effect of hydrated lime on the strength of concrete:

"Numerous tests have demonstrated that the compressive strength of concrete is little affected by the presence of hydrated lime, the majority show a slight increase, when the tests have been conducted under conditions approximating field conditions. With the exception of absorption and permeability, both of which are materially decreased, none of the other properties of concrete are affected to any great degree."

As a result of many thousand tests made in this Laboratory, we concluded that "In usual concrete mixtures, each 1% of hydrated lime (in terms of the volume of cement) **reduced** the compressive strength 0.5%; 1% by weight reduced the strength 1.2%.... The tests were made 2 or 3 years ago, but we have found no reason to alter conclusions.

The effect of hydrated lime in concrete highways was clearly shown in the Bates Road test by the Illinois Division of Highways as reported in their official bulletins and summarized in the Engineering News-Record, August 10, 1922. This test was made on an actual road built in the field and tested by means of truck traffic. A 4-in. slab of 1-2-3½ concrete using 7.5% hydrated lime failed completely under the second traffic run (rear truck wheel load, 3,500 lb.), while the next slab of same composition, except no lime, showed no failures at this load, and gave much better results under subsequent loads.

A properly-made concrete needs no assistance that hydrated lime can give. One feature of modern practice which must be guarded against is the tendency to use too much mixing water and too little curing water. The greatest enemy of concrete is too much mixing water. Hydrated lime simply exaggerates this difficulty, since additional water is required on account of its presence.

Yours truly
Duff A. Abrams
Professor in charge, Structural
Material Research Laboratory,
Lewis Institute, Chicago

Traffic Recommendations

At the recent meeting of the American Society for Municipal Improvements the Committee on Traffic and Transportation submitted a report which is devoted to tentative recommendations some of which are quoted herewith.

Maximum width of motor truck chassis or body 96 inches.

Maximum overall height from base of tire to highest point of vehicle or load, 12 feet, 6 inches.

Maximum overall length vehicle, body and load, 30 feet.

Maximum weight per linear inch of width of solid rubber tires measured at the base of the rubber, 800 pounds.

Maximum gross weight on one axle, 22,000 pounds.

Maximum gross weight of motor truck and load, 28,000 pounds.

In its 1923 report, the committee intends to present recommendations pertaining to trailers and maximum speeds for motor trucks and trailers operating within cities on different classes of streets for different types of motor trucks and trailers.

The committee submits the proposal that the cost of reconstructing pavements and foundations on streets in business districts and main through trunk thoroughfares be financed by general appropriations and in no cases of such streets by assessment against abutting property.

Railroad grade crossings are a constant source of accidents. It is evident that their total elimination is desirable but unfortunately is not practicable in all cases in the present state of the financing of highway improvements. Much can be done by proper design to reduce traffic hazards in the case of railroads crossing highway at grade. A clear sight of the railroad crossing for five hundred feet on each side materially reduces accidents and a clear sight of the railroad for a thousand feet on each side of the highway is desirable. The width of all roadways crossing railroads should be at least twenty feet. For a distance of one hundred feet on each side of the railroad, the grade of the highway should be level or not over two feet rise or fall in one hundred feet. The suggestion by some officials to construct humps in the highway to slow down traffic approaching railroad crossings is unreservedly characterized as pernicious.

Proper danger signs should be located at two hundred feet each side of grade crossings in municipalities and, in sections which are poorly lighted at night, a large electrically lighted rectangular sign carrying the word "Danger" in red letters should be suspended directly over the centre of the street at the grade crossing.

A New Element in Town Planning

Community Playgrounds Comprising the Back Yards of a City Block Would Offer Recreation Centres and Avoid Street Accidents—Central Heating also a Possibility

By W. G. CAMERON, B.A.Sc.

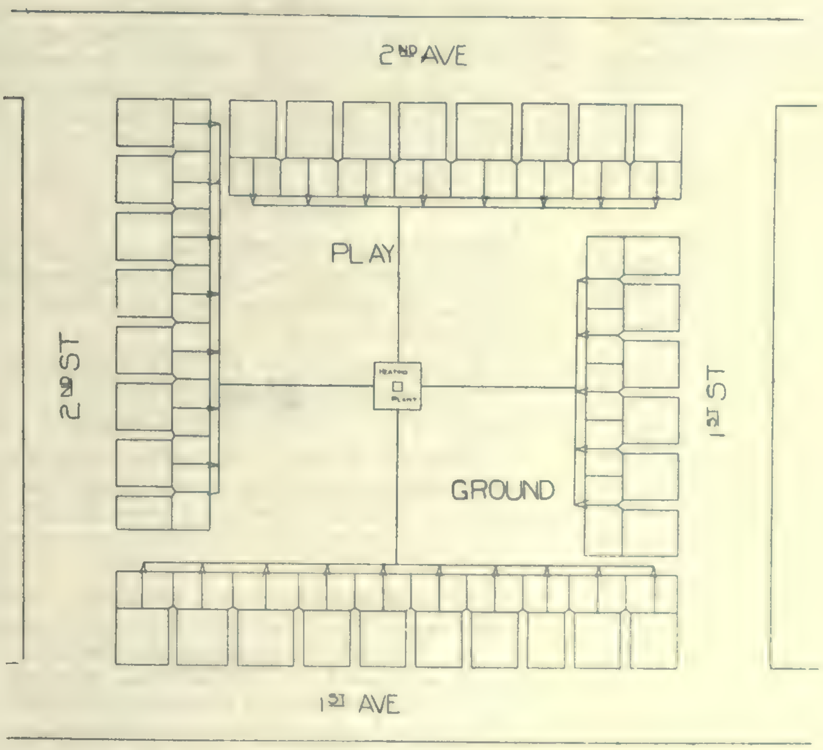
We often hear these days of children being injured or killed on the streets by the traffic. As the city grows larger these unfortunate accidents must become even more numerous. Of course, there is a remedy—keep children off the streets, but playing with the confines of the average city back-yard does not tend to develop a very robust type of citizen. The city of Toronto has done much to remedy this evil by supplying parks and playgrounds, but these only partly relieve the conditions as they are too far away for many of the younger children.

It is suggested that the modern city block might very well be laid out as shown in the accompanying sketch. The average resident does not make any use of his back-yard and those who do would very willingly give them up for a purpose of this kind and in laying out new districts the blocks could be planned accordingly. Besides the advantage already recorded the citizen would gain two others, namely central heating and room for a car.

The central heating would be a boon in a year like this when people would be likely to get all the steam coal they wished but could not get anthracite, for which central heating, soft coal would be used and steam heating would be the rule instead of hot air.

The day is not far distant when the motor car will be within the reach of every man and then the house where room for a car is provided will be even more in demand. In this plan an entrance is provided for cars at two corners of the block, while there would be space for several cars in the rear of each house. There would also be a gate from each yard to admit one into the play ground. This play ground would be too small for ball games but as there are areas provided for this purpose, and as small children do not play ball games, the game would not likely be missed. The central heating plant would likely be under ground. The area could be supervised and decorated adequately by the proper authority.

Considering this then as a scheme adaptable to any city block, we must think of the pros and cons. First, we would have the children in a safe place with none of the constant worry we have when they are on the street. The children themselves would find such a place attractive as they would escape the constant warnings and would meet other children to play with. Every citizen would have the equivalent of a side drive. He would have central heating and thus avoid all the evils attendent on furnaces. He would have a smaller lot and therefore less taxes. There are likely other advantages that have not been mentioned and some disadvantages, chief of which are increased noise in the rear of the house and restricted back yards.



How the backyards of a whole block may be converted into a recreation area with a central heating plant and garages for every house.

Should Winter Curtail Construction?

An Analysis of Methods of Doing Work on All Types of Construction in Cold Weather—The Change from a Seasonal to a Year-Round Industry is the Big Problem, Unsolved as Yet

By C. S. Hill in "Engineering News-Record"

Construction generally is curtailed in winter. During this comparatively idle period the industry is sustained by drawing on what is earned in the portion of the year when it was active. The correction of this condition is a task which engineers and contractors are called upon to undertake as their share in solving the great problem of reducing industrial waste.

Winter construction presents a technical and an economic problem. The technical problem is to develop effective construction practices for cold weather; it has to a considerable extent been solved. The greater problem is economic and almost no purposeful effort has been made to solve it. It involves the stupendous labor of changing construction, with its correlated activities, from a seasonal to a year-around industry and the simultaneous changing of building habits.

Obviously, reformation of the country's second largest industry cannot be accomplished out of hand. It is possible, however, to state the problem, to disclose the means that have been employed to solve it and possibly to suggest further means. A comparatively superficial examination indicates amazing possibilities of immediate progress, particularly in codifying and correlating methods of cold weather construction.

Governing Conditions

Cold affects adversely every element of construction: labor, water supply, drainage, materials, equipment, transportation and structure suffer disturbance. Extreme frost aggravates the effect of cold, and wind and snow magnify the action of frost. From these two facts come the first two general conditions of winter construction.

1. Winter construction is a different problem in different temperature zones.

2. In any locality the possible volume and continuity of winter construction change as the season is mild or severe, is open or has a heavy snowfall, is of even or fluctuating temperature and has few or frequent storms.

Certain construction processes are obviously more susceptible to disturbance by cold weather than are others. Shallow excavation and fill over wide areas, steel erection high in the air and concrete road construction are practically exposed to the effects of frost and storms. Tunneling or deep excavation in cuts or pits of small area and interior building construction are comparatively sheltered. From these facts comes a third generalization:

3. The nature of the construction operation largely determines the practicability of its successful prosecution in winter.

On the face of the three conclusions which have been stated, the problem of winter construction appears to have complexities. This is true if the economic solution is being sought. While the technical solution differs with temperature and weather conditions, the difference lies in the degree to which cold weather construction methods are required and not in the methods which have to be employed. Once the processes are determined for, say, excavation or concrete construction, the only change in practice required in any circumstances of temperature and weather is the extent to which all or any of the processes have to be employed. A fourth general condition results:

4. Weather and temperature conditions determine the extent to which cold weather construction methods may be necessary but do not necessitate any change in the nature of the methods.

Statement of Problem

With these fundamental conditions established the problem of winter construction is to determine (1) the kinds of construction which can be performed in winter; (2) the methods of and equipment for cold weather work; (3) the extra cost of doing winter work and (4) the expenditure warranted to secure the increased production resulting from operations. A fair start has been made in determining the kinds of work that can be done and the methods of doing it. In some kinds of construction, particularly concrete building work, the excess cost of winter construction has been fairly well established; but experience furnishes no facts of importance on the economics of winter construction as a general practice.

The progress that has been made in winter construction is the best promise of its future possibilities. To make the statement specific, consideration is limited to heavy excavation, road building, municipal works and concrete and building construction. As a matter of fact, however, other operations introduce few conditions which require different methods, so that the determinations reached for the operations named comprehend construction in general.

Heavy Excavation

The following conclusions have been set down from notes on about twenty steam shovel or dragline heavy excavation operations described in technical journals or personally observed:

1. With preparations and precautions which can be carried out without serious difficulty heavy excavation can be confidently undertaken in winter.

2. Generally depth of cut and volume of material in a restricted area determine the feasibility of winter operations. Shallow cuts not penetrating the frost crust are not practicable except as emergency operations.

3. Labor is somewhat less efficient in cold weather. Men have to be relieved from work at intervals to warm themselves, particularly those working in exposed positions like that of cranesman on a steam shovel. Warm clothing is necessary—not merely anything that will keep out the cold but clothing designed to allow bodily activity like, for example, the outfit for Red Cross workers in Russia. In the most severe frost, shorter working days are necessary. On the

other hand, owing to general winter idleness, more choice is possible in the men employed.

4. Motorized hauling equipment—motor trucks, tractors and locomotives—and in general machinery for all operations should be used to the utmost extent because it reduces the number of men and teams to be affected by cold and has excess power to meet the more difficult operating conditions caused by frost.

5. Water supply, except when urban supply is available, is expensive. Surface pools and pipe lines will not do. Frost-protected pumps, pipes and tanks or tank-car haulage are required.

6. Excavating equipment has to be prepared for winter work by insulating steam pipes and cylinders and closely housing every working part which it is practicable to shelter.

7. Snow beds and barriers help to keep pits and cuts free from drifted snow and can often be installed at small expense.

8. Efficiency is gained by blasting the frozen crust, particularly in dragline work, and it is generally advantageous to "dig in" before frost so as to have a good working face when frost comes. In winter blasting the use of non-freezing explosives or of means to keep explosives unfrozen are essential.

9. If the cold is particularly severe and continuous, double-shift operations, so as to keep ahead of the frost, may, in large operations, be possible.

10. Power-dump cars are superior for handling spoil, usually mixed with snow and liable to freeze so that it is hard to dump. Prompt movement of spoil trains is necessary for the same reason.

11. More capable supervision is required to meet the hazards of frost and storm.

12. Electric-motor or gasoline-engine-driven equipment greatly reduces the difficulty of water and fuel supply.

Road Building

Second to industrial and residence building-construction, road building is the most general construction operation and involves the largest expenditures. As a winter construction problem it, therefore, has great economic importance. It also introduces conditions of earth moving, hauling, water supply and fabrication of structure (paving or surfacing) which are not common in general excavation and in concrete and building construction.

Earth moving in road construction generally involves shallow cuts and fills. Where heavy cuts and fills have to be made the conditions are those of heavy excavation just previously considered. Cuts and fills not deeper than the frost crust are practically impossible once the crust has frozen. It has been found practicable, where the grading has been completed, to prevent freezing for a time while pavement was being constructed. The method was to stretch three lines of pipe from a steam roller along the subgrade and to cover them with straw and a canvas blanket. In general the following conclusions are warranted:

1. Except as an emergency operation and except in cuts and fills of considerable magnitude winter grading of highway is impracticable.

While grading is, broadly speaking, not a winter possibility, the next most important operation of hauling is made easier in some respects by cold weather. Frost hardens the ground. Snow gives a track for sleds. If storms are not too frequent winter hauling is entirely practicable in road building (1) to stockpile construction materials and (2) to distribute gravel surfacing. In Wisconsin and Minnesota many miles of gravel surfacing have been successfully and economically placed in winter. Stated as a conclusion:

2. In road building the hauling of construction materials and equipment is entirely practicable in winter with probably no more delay because of wind and snow storms than is experienced in summer because of rainfall.

Water supply in winter road work is even more serious a problem than it is in heavy excavation; conclusion (3) under heavy excavation applies to water supply for road building, and is here repeated:

3. Water supply, except where urban supply is available, is expensive. Surface pools and pipe lines will not do. Frost-protected pumps, pipes and tanks or tank-car haulage are required.

There are numerous examples of winter paving operations which have demonstrated that any kind of pavement may be constructed by (1) heating the materials; (2) housing and heating the subgrade and the complete pavement; (3) using chemicals to retard freezing. These are all common processes in concrete building construction and are described in many articles and books.

There are virtually no records of the extra cost of winter road building. It has been variously assumed as 25 to 50 per cent more than the cost of summer construction, but these figures are nothing but guesses.

Winter road building is not practicable as a general proposition in places having a severe winter climate; it is practicable to prolong the construction season well into the fall season of moderate night frosts by methods which do not call for elaborate equipment or excessive expenditure; it is also practicable to do in winter a large amount of hauling and storing materials and other work preparatory to warm weather construction.

Municipal Works

The only recorded study of winter construction practices has been made by Canadian engineers. In 1920, inquiry made by Prof. W. Clifford Clark, Queen's College, Kingston, Ont., of 36 Canadian cities which had done municipal work in winter, disclosed the following information:

The kinds of work pronounced successful, or fairly so, are sewer construction, tunneling, deep excavation, heavy cuts and fills, mass concrete and work in muskeg or swamp where subsurface water prevails. The degree of success depends upon the preparation which is made in the fall for continuing work in severe weather and also on the supervision of the work.

Estimates of the increase in the cost of construction in winter vary from nothing to double the cost of summer work. In some instances winter construction was found less expensive. In all cases the kind of work and the local weather conditions must be taken into account.

There is general agreement that tunneling can be done as economically in winter as at any time. The average increase in the cost of rock excavation is less than 25 per cent. In ordinary sewer work the increase probably runs from 25 to 100 per cent.

Various reasons are given for the increased cost. The frozen top has to be broken through. Spoil banks freeze. Brick and concrete materials must be heated. Workmen have to be sheltered and provided with means of warming themselves.

In general winter work keeps organizations intact, overhead charges are spread over twelve months and wages are lower.

Concrete and Building Construction

Work on concrete structures of all kinds, and building operations generally, are commonly carried on in winter. Methods have been highly perfected and are now text-book knowledge. The conditions can be stated as follows:

1. All concreting and building masonry operations can be carried on in winter with dispatch and absolute safety by heating the materials, housing in the work under construction and heating the enclosure.
2. Steel erection in winter is largely a function of storm and temperature. In any weather in which the workmen can withstand the cold and work safely, structural steel can be erected.
3. Interior building work, plumbing, steamfitting, plastering, etc., can be performed in winter with little loss of efficiency.
4. Winter construction in building adds from 3 to 10 per cent to the cost according to the records of large concrete building contractors.
5. There is probably some greater risk of poor workmanship in winter concreting, masonry work and steel erection which calls for more exacting supervision and inspection.

General Conclusions

Nothing in the general conditions laid down, or in the conclusions from practice, place the problem of methods of winter construction beyond the range of easy solution by engineers and contractors. With very moderate inquiry and analysis it would be practicable to state recommended practices or standard methods. This investigation may precede more complex study of economic conditions because whether or not winter construction in general is economical there are always individual operations which it will pay to carry on in winter. In other cases, such as winter hauling in road building, it may be profitable to perform parts of the work in winter. As a broad generalization of the technical problem of winter constructed it may be concluded:

Any kind of construction can be performed for which the owner is willing to pay cold weather prices.

Economic Problems

The economics of winter construction do not lend themselves to the simple methods of handling the technical problem. As applied to a single structure the economic question is: Will possession of the structure at a definite earlier date be of enough value to pay for the extra cost of winter construction and leave a little over? Visualizing the construction industry as a whole the query is much the same. While, however, in the case of the individual structure the means are at hand for a ready answer there are inadequate, indeed almost no, data by which to determine the answer for the whole industry. Determination of these data is the great task or research before engineers and contractors and the determination needs to be quantitative.

Briefly, winter construction appears to offer economies by (1) spreading overhead costs over twelve producing months instead of some less period; (2) reducing the seasonal employment of men in construction and the allied industries; (3) ironing out the peak in the curve of production of construction materials and equipment; (4) equalizing the demand on transportation agencies. The economic waste in all these activities due to reduction of construction during cold weather is universally admitted as a general truth but there are no determined figures of the amount of waste. The quantitative data are what research is called upon to supply. The reasons are:

1. The construction industry is the servant of the building public and evidence of specific savings is necessary to induce the building public to alter its practices.
2. Without full knowledge of the economic waste from winter idleness in construction the industry cannot stabilize its own business or assume the duty, which it must, of teaching the building public.

What is Mill Construction?

Often Some Misconception About the Meaning of the Term—General Characteristics of the Type

We all laugh at the "gentleman farmer" who thought that ensilage was some kind of a bug. But we should not laugh too soon, for we have allowed many prospective builders of factories and other industrial buildings to remain in about the same position in regard to the type of buildings known as "mill construction."

What Mill Construction Is

The term "mill construction" as commonly used is the name given to that type of building in which the interior framing and floors are of timber, arranged in heavy solid masses, and smooth flat surfaces, so as to expose the least number of corners, and to avoid concealed spaces which may not be reached readily in case of fire.

A broader interpretation of the term includes the meaning given above and adds the specification that the building shall be so constructed that fire shall pass as slowly as possible from one part of the structure to another. This means that each floor should be separated from all others by incombustible walls or partitions, and by doors or hatchways which will close automatically in case of fire near them. Stairways, belt passages, and elevator shafts are encased or preferably located in fireproof towers. Openings in floors for passage of belts, etc., are either avoided or fully protected against passage of fire or water. The proper installation of an approved automatic sprinkler system is of great importance.

Ceilings in rooms where highly inflammable stocks are kept or where hazardous processes are followed, should be of fire-retardant construction. The ceiling should follow the lines of the timbers without an air space between the two surfaces.

Three general types of framing may be classed as follows:—

1. Floors of heavy plank laid flat upon large girders which are spaced from 8 to 11 feet on centres. These girders are supported by wood posts or columns spaced from 16 to 25 feet apart. This type is often referred to as "Standard Mill Construction."
2. Floors of heavy plank laid on edge and supported by girders which are spaced from 12 to 18

feet on centres. These girders are supported by wood posts or columns spaced 16 feet or over apart, depending upon the design of the structure. This type is called "Mill Construction with Laminated Floors."

3. Floors of heavy plank laid flat upon large beams which are spaced from 4 to 10 feet on centres and supported by girders spaced as far apart as the loading will allow. These girders are carried by wood posts or columns located as far apart as consistent with the general design of the building. A spacing of from 20 to 25 feet is not uncommon for columns in this class of framing where the loading is not excessive. This type is more generally known as "Semi-Mill Construction."

Each of these types is provided with a lighter top-floor to take the wear and give a finished surface.

Main Points of Mill Construction

Walls	Brick. concrete, or heavy timber.
Beams and Girders	Timber at least 5½ in. thick.
Posts	Timber at least 7½ in. by 7½ in.
Under Floors	Timber at least 2⅝ in. thick.
Wearing Floor	Timber at least ⅞ in. thick.
Roof	Timber at least 2⅛ in. thick.
Height of Building	65 to 90 feet.
Size of Rooms	6,500 to 20,000 sq. ft. floor area.
Cost of Insurance	Low. About the same as for "fireproof" buildings when both are equipped with sprinklers.

Why Engineers Should Interest Themselves in Building Ordinances

Building ordinances are laws regulating the kind and quality of materials and the methods used in applying them in building; in short building ordinances contain specifications for all types and classes of buildings, and therefore, should be most carefully formulated to cover all conditions involved in construction in order to acquire the best results.

Wood is used in some form in every type of construction and for this reason architects, engineers and contractors should be familiar not only with the materials themselves, but thoroughly posted on the requirements of building ordinances in order to recommend and use intelligently such lumber as will be acceptable and best suited for the purpose used.

The four types of construction under which buildings are usually classified are as follows. Fire-resistive; mill or slow-burning; ordinary; frame.

A "fire-resistive" building contains no wood except in door and window frames, doors, sash, casings, baseboards, finished floors and the furring strips under them, as well as all partitions contained within a private apartment.

The interior framing, floors and roof of "mill construction" buildings as well as those of an "ordinary" (masonry wall and woodjoisted) buildings may be of wood. "Frame" buildings, which include a larger percentage than any other type, may be constructed entirely of wood.

Many of the important specifications to be considered in the use of wood may be found under the following heads:

Kind, quality, stresses, preservation, prevention of spread of fire.

The kind of wood best suited for the use to which it is to be put should be known to the engineer or architect in order that he may recommend with assurance the material which will stand stresses where necessary, will wear best where wear is required, and take desired finishes properly.

The quality of material to be used should be carefully defined and no lumber having defects whereby the strength may be impaired should be permitted to be used where restricted, and the engineer and architect should be responsible for seeing that no low grade material is furnished where a higher grade is called for.

In many codes the stresses for structural timbers are incorrectly stated, which give lumber unfair consideration as compared with other materials. The Forest Products Laboratories have made tests to determine correct unit stresses for wood which are the most reliable tabulations available and should be made a part of every building code.

In recent years science has developed means by which the life of wood may be extended by the use of preservatives, especially where unfavorable conditions of atmosphere and temperature prevail. Specifications recommending the treatment of wood by these should be made a part of every building code.

Since wood is classed among combustible materials, it is essential, that it be properly protected from fire and that adequate fire-stopping be specified to impede the progress of fires after they have once started. There are many precautions to be employed to protect against damage by fire and to prevent its spread, such as regulating the construction of chimneys and fire places, locating heater and stoves, limiting floor areas and heights of buildings, kind of receptacles in which to keep ashes, proper distance between buildings and many other measures which have been devised for the purpose of protecting life and property.

Meetings of the Toronto Branch of the Engineering Institute

The executives of the Toronto branch of the Engineering Institute of Canada have decided to hold ten meetings between now and Christmas and ten from the middle of January until the annual meeting on March 15th. Arrangements have been made to bring before the branch speakers of outstanding ability who will deal particularly with the business side of engineering. Such subjects as municipal finance, the local improvement act, public speaking and the giving of expert evidence will be dealt with by men well qualified to speak on such matters. Evenings have been set apart for discussion on town planning, fees and policy, while the remaining evenings will be taken up by technical engineering subjects. An effort will be made to develop the social side as well as introducing a debate on some live topic.

In his inaugural address recently Mr. Wm. Storrie chairman of the branch urged the development of sectional meetings. His case was stated as follows: "In common with others I believe the Toronto Branch is large enough in members to try out sectional meetings. With this object in view I intend asking the Executive to make a start with a "Municipal Section," giving this section full charge of four out of the ten meetings to be held after Christmas. I should like to see this given a fair trial and should the Executive decide to proceed with the formation of such a section I hope those members of the branch who are interested will give it their hearty support."

Street and Sidewalk Design

Report of a Committee of the American Society for Municipal Improvements

It might be said that only of camparative recent date has the subject of street and sidewalk design been attempted in a scientific manner, for comparing the answers to the committee's questionnaire it is noted that in older cities, with the exception of recent layouts, street design is far behind that in the newer cities.

Widths of Roadways—Replies to the question on this subject show conclusively that the width of roadways should be based on the number of lines of traffic to be accommodated and while but a very few cities report that they give consideration to the density of traffic to aid them in establishing the necessary number of lanes yet the Committee feels that a study of present and prospective amount of traffic is very important.

Traffic Lane Widths—Analysis of the replies received would indicate that for each line or lane of traffic a width of from 7 to 8 ft. is necessary for motor vehicles parked at the curb and from 8 to 10 ft. for vehicles moving, with a somewhat greater average width in business than in the residential sections. Space for street car tracks should be from 8 to 9 ft. for single and 18 to 20 ft. for double track.

Alleys—In a city laid out on the rectangular system, alleys are of special value, since in them may be placed sanitary sewers and unsightly poles. Alleys also afford access for deliveries to residences, for the collection of garbage and rubbish and to garages on the back of lots. Alley widths should not be less than 18 ft.

Widths of Sidewalks should be determined by the intensity of traffic. From the replies received it appears that the best practice is a width of from 5 to 6 ft. for residential sections, and from 10 to 15 feet for business sections.

Grass plats afford space for trees, poles and hydrants and widening of the traveled roadway without the acquisition of additional land. Where trees are planted, grass plats should not be less than 5 ft. wide. A number of cities allot from 1 to 2 ft. of grass space between the sidewalk and the property line, when the grass plat is next to the curb.

Safety Zones—The general practice is to paint the pavement with lines which designate the area or zones where vehicular traffic must give way and look out for foot traffic. These lines may mark zones where street car stops or they may mark crossings for foot traffic from one sidewalk to the other. The zones where street cars are approached are usually 6 ft. in width and of proper lengths and a safety walk from the middle of the zone to the sidewalk on the side of the street where zone is marked off is advantageous. In a number of cities a 4-in. platform of plank or concrete is constructed. In other localities posts or stands connected with ropes are installed.

Sidewalk Crossings—There is a tendency to get away from the step at the curb to the street at street intersections, especially where the foot traffic is heavy Such steps should not exceed 6 inches.

Radii of Curbs at Street Corners—Before the introduction of the automobile and motor trucks, a 6 or at the most 8 ft. radius curb was considered adequate. Under present conditions in new layouts the radius of the curb in residential sections should not be less than 10 ft. In business sections, from 10 to whatever limit can be introduced according to width of sidewalk and roadway. For alleys, 5 to 6 ft. radius is sufficient.

Catch Basin Inlets—Catch basins should be connected directly to the sewer at the manholes, by means of an individual pipe. They are generally located at street intersection, but where necessary to increase the number intermediate inlets may be located in the middle of the block. Modern practice provides for the entrance of the water into the catch basin through [ungrated] openings either cut out of the curb or better through openings in castings set in the sidewalk flush with the curb.

Street Crowns—Generally the grade varies directly with the width and inversely as the function of the grade of the street. A quite general practice is to fix the crown from 1/60 to 1/100 of the width, depending on the grade and character of service. Analyzing the answers to our questionnaire, the following appears to be the general practice where grades of streets are normal and where the surfacing of the pavement is concrete, brick, bituminous or surfacing of light nature: For street width of 20 to 22 ft., the amount of crown 4 in.; 24 to 28 ft., 5 in.; 30 ft., 5½ in.; 32 to 42 ft., 6 in.; 45 ft., 7 in.; 48 to 52 ft., 8 in. For rough surfaced streets, such as granite block, the crown should be increased from 20 to 25 per cent; for macadam or gravel 15 to 75 per cent; and where the grades of the street exceed 4 per cent the amount of the crown can be reduced in proportion to the grade, from 20 to 40 per cent.

Gutters—Where very flat grades are encountered the slope of the gutter is often made much steeper than the general crown of the street and in a number of instances cited the slope may be as heavy as 1 to 3 in. to the foot.

Niagara Peninsula Branch, E.I.C.

On Friday, October 20, the Niagara Peninsula Branch of the Engineering Institute of Canada held a dinner meeting at the Welland Hotel, St. Catharines, when discussion took plare on registration under the new Professional Engineers Act. In addition, Captain T. S. Scott, city engineer of Niagara Falls, Ont., read an excellent paper on "Roads." F. S. Lazier is chairman of this branch and R. W. Downie is secretary.

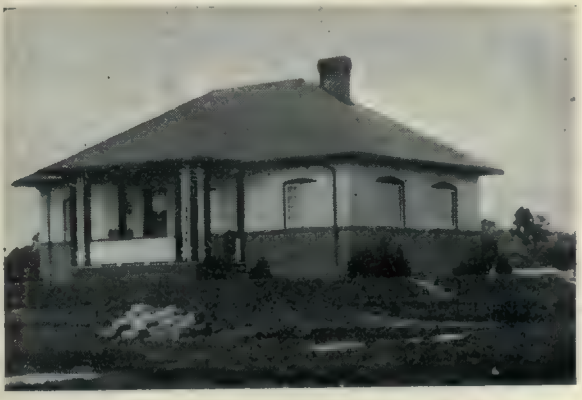
The Toronto Branch, E. I. C.

The meeting of the Toronto Branch of the E.I.C. tomorrow evening, the 26th inst. will be given over to a discussion of basic principles of the Town Planning Bill brought before the Legislative Committee enquiring into Town Planning Legislation by the Conference of the Ontario Town Planning and Housing Association. Mr. W. S. B. Armstrong, secretary of the association, will bring to the attention of the meeting the necessity of provincial supervision in town planning matters, and Mr. H. E. Redman, solicitor of Scarboro Township, will speak on the relationship of the suburban area to the large urban centre. The bill, as a remedy for present inability or negligence to properly plan Ontario communities, will then be described and placed upon the table for discussion. Mr. N. D. Wilson will be in charge of the meeting. All interested are invited.

The Contract Record's

Weekly House Suggestion No. 41

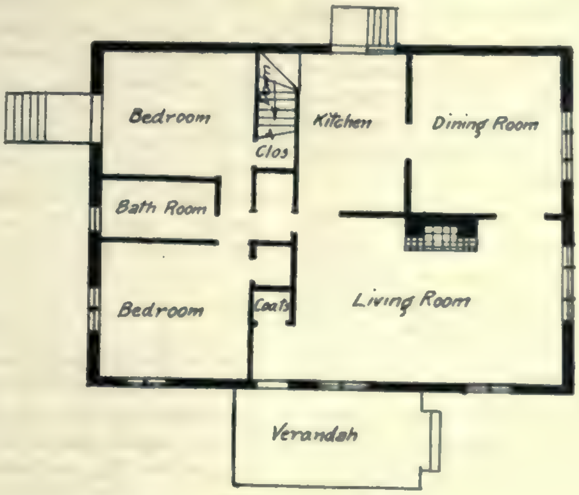
We are presenting in our series this week an ideal example of the well-planned, popular, five-room bungalow. The foundations are brick and the walls are stucco on brick. There is an attractive and roomy verandah at the front, from which the main entrance opens onto a short hall. The main feature of this house is the beautiful living room, which is located immediately to the right on entering. This room is 21′ 2″ x 13′ 11″ and also has entrances on dining room, kitchen and the cross hall leading to the bedroom section. The walls and ceilings in this room are of interior stucco; the flooring and trim is of plain red oak, the latter being finished a dark fumed. There is a beautiful tapestry brick fireplace located in the centre of the rear wall. The dining room is entered from the living room through a wide, open entrance and is also connected with the kitchen by a swinging door on the left. The flooring and trim of the dining room is the same as living room and there is a stucco ceiling to plate rail. The kitchen has an entrance from the rear and also opening to cellar stairway. The flooring and trim here is of pine, the latter finished in white enamel.



The bedroom section is approached through a short cross hall and contains two good-sized bedrooms and bathroom. The flooring and trim here, as in kitchen, is in pine, the trim being finished in white enamel. There is an entrance on the rear bedroom from the outside, as seen on reproduced plan, through glass doorway on the left.

There is a full basement under the house, with boiler room, laundry, coal space, etc.

Mr. H. Addison Johnston, well known Toronto home-builder, built this attractive little bungalow in North Toronto.



Study of Sewer Pipes

The U. S. Bureau of Standards has undertaken an investigation of the condition of sewer pipes in the city of Los Angeles, Cal., for the purpose of studying the effects of sewage and sewer gases on clay and cement pipes, both of which are now being extensively used in that city.

In this work the Bureau is co-operating with the clay and cement pipe manufacturers and the office of the city engineer. The program for the investigation involves the excavation and inspection of sections of pipe from laterals in various parts of the city, and the replacement of these with tested pipe for future examination.

The object of the investigation is to determine by chemical survey general relations between rate or extent of deterioration of pipes and concentration of damaging elements in the sewage and gases. The problem is a difficult one, not only on account of the extent of the work involved, but more particularly because the field which it enters is as yet unexplored.

Mainly Constructional

East and West—From Coast to Coast

The John. V. Gray Construction Co. Ltd., 541 Queen E., Toronto, have opened an office in Haileybury, Ont., under the managership of Mr. J. MacMillan.

Authorities of Laval University, Quebec, P. Q., have announced their intention of erecting a new building and extending the present structures of the university, at a cost of $500,000.

L. E. Shaw Ltd., Avonport, N. S., have made arrangements with the Interlocking Tile Co., 32 Toronto St., Toronto, whereby the former will manufacture Interlocking Tile for sale in the provinces of Nova Scotia, New Brunswick and Prince Edward Island.

Good progress is being made on the municipal incinerator at Chatham, Ont., the furnaces, according to a very recent report, being 30 per cent. constructed, building and approach 50 per cent. constructed and a start was made a few days ago on the radial brick chimney.

Thirty million feet of spruce timber has been destroyed by fire in the McArthur timber limits, on the Athabasca River, according to a recent statement of Col. R. H. Palmer, head of the forest service for Northern Alberta, who has been supervising fire fighting operations.

The council at Sandwich, Ont., recently granted the Sandwich Board of Public School Trustees the sum of $266,041 for the construction of a new 10-room school on Felix Avenue. The new school will be equipped with a gymnasium and auditorium and will be modern in every respect. The general contract has been awarded to the Windsor Construction Co.

The ratepayers of Hanover, Ont., recently carried a by-law to expend $135,000 on waterworks additions. Water will be brought from Rhurl Lake, three miles away, for domestic and commercial purposes, and the new equipment will furnish good fire protection. A reservoir will be erected at the lake and a water tank in the town. Additional water mains in the town are also provided for.

The output at the British Empire Steel Corporation's wire mill at Sydney, N. S., will be doubled by the installation of new equipment, work upon which began a few days ago. Part of the outfit is a galvanizing frame, which will enable the company to turn out 120 tons of fence material a day, instead of 60 tons, as at present. The new construction will be completed by February.

The following is a list of officers elected at the annual meeting of the Ontario Town Planning and Housing Association, held recently in Toronto: President, J. P. Hynes, of Toronto, (re-elected); vice-presidents, T. S. Morris, Hamilton; W. W. Hiltz, Toronto; T. J. Murphy, London; Ald. E. D. Lowe, Ottawa; secretary, W. S. B. Armstrong, Toronto; treasurer, Gordon Philip, London; executive committee, N. Cauchon, Ottawa; Ald. H. E. Rose, St. Catharines; Ald. R. W. Gladstone, Guelph; J. Clarke Keith, Windsor; Mrs. Ald. Small, Toronto; Mrs. M. F. Irwin, Toronto; L. M. Allan, Windsor; Major W. D. Sharpe, M.D., Brampton; Mrs. Harry Carpenter, Hamilton; Ald. A. W. Hilborn, Brampton; Frank Cockshutt, Brantford; A. V. Hall, Toronto; T. H. Everson, Oshawa; Col. S. W. Ray, Port Arthur; B. Lade, Fort Erie; Mayor LeHeup, Haileybury, and H. O. Lundy, Windsor.

Personal

Mr. F. C. Clarke has resigned the position of industrial commissioner of Niagara Falls, Ont., and his resignation was accepted by the city council at a recent meeting.

Hon. G. D. MacLean, Provincial Secretary and Minister of Education, British Columbia, has been sworn in as Minister of Railways for the province. He succeeds Hon. John Oliver, who recently resigned that portfolio.

Mrs. H. B. Dunnington Grubb, landscape architect of Toronto, was the guest of the Hamilton chapter of the Ontario Association of Architects, at their first luncheon of the season at the Royal Connaught a few days ago.

Mr. H. R. Myers, Stratford, Ontario, has recently received the appointment of instructor in civil engineering in the College of Applied Science, Syracuse University, and entered upon his duties at the beginning of the present term.

Mr. H. J. Stambaugh, Jr., has been appointed general sales manager of the Burlington Steel Company, at Hamilton. Mr. Stambaugh was formerly vice-president and general manager of the Trussed Concrete Steel Company of Canada, Ltd., at Walkerville.

The Ontario Gypsum Co. Ltd., of Paris, Ont., will be represented in the Windsor district by Mr. W. J. McCann. Mr. McCann was formerly with the J. Muldoon & Co., of Toronto. He will devote his whole attention to the Border cities and immediate vicinity.

The Federal Government has appointed Mr. William Ainslie, Hamilton, chairman of the Hamilton Harbor Commission. Messrs. John Newlands and William B. Sheppard have been appointed members of the commission. The new members succeed Messrs. William J. Clark, George J. Guy and A. C. Garden.

Obituary

Mr. David Carlyle, well known Toronto builder and concontractor, died in that city recently after an illness of about six months, at the age of 66 years. Deceased was born in Toronto and educated at Jarvis St. Collegiate, and for some time was in the fire insurance adjustment business with his son.

Trade Incorporations

The Leamy-Couture Construction Company, Limited, with head office at Hull, P. Q., capital $50,000, to carry on a general contracting business.

ESTABLISHED 1886

Contract Record
and Engineering Review

A National Journal for the Construction Interests of Canada,
reaching Architects, Engineers, Contractors
Municipal Officials, etc.

Published Each Wednesday by
Hugh C. MacLean Publications
LIMITED
THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News,
Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES
Canada, Great Britain and British Possessions $3.00. U. S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 **Toronto, November 1, 1922** **No. 44**

When Labor is Overpaid

Something is surely wrong with an economic system that permits plasterers to make $26 a day during the week and as much as $32 for four hours' work on Saturdays and Sundays. And yet these are the wages that are reported to be current in Chicago. In that city, the unions so control the master plasterers that $2.00 an hour and a $10-a-day bonus is the accepted rate applicable to week days, while on Saturday afternoons and Sundays the hourly wage is doubled. It is reported that the contractors and unions have signed up for three years on this basis.

It is impossible to reconcile in any way these wages with the amount or quality of work turned out. No one can say that $26 a day is a true measure of a plasterer's work; in other words, no plasterer is worth $26 a day. His work is not of such supreme merit, nor does it demand such unusual intelligence and ability that $2 an hour and $10-a-day bonus is a fair recompense. This is not said in a derogatory way at all, for plastering is undoubtedly an art that requires a greater degree of skill—far more than is usually evident in most plastering operations—but the fact is nevertheless evident that in a $26-a-day wage scale, there is no semblance of any just relationship beween the work turned out and the payment made for that work.

Yet it is such a relationship that should govern toil of all kinds. A day's pay for a day's work, tempered by the law of supply and demand, should be the governing principle in labor relations. And no organization or other force should be permitted to bolster up a wage beyond what is recognized as a just equivalent of the work turned out. Neither should any organization be permitted to exploit labor so as to reduce wages below that standard. Value for value received should be the ideal of labor relations. Judged by this qualification, Chicago plasterers are overpaid—so much beyond the amount necessary to live decently that it tends to make the workers soldier on the job to the extent that output and efficiency are very seriously impaired.

Fortunately, Chicago conditions find little suggestion of repetition in Canada. Yet there are elements in our labor bodies that would fain adopt Chicago's system as an ideal and wring out of the contractors and the owners the last possible cent while returning the least possible labor. Such action will do nothing but squelch the activity of the building industry. Let's hope that the saner elements of labor will prevail in their recognition of the fairness of the principle of value for value received.

Who is Responsible?

A very nice question is raised by a discussion that recently took place in the House of Commons. This question was the wretched acoustics of the Commons Chamber. It was raised on the last day of the session by Mr. Logan, the member for Cumberland, and though his remarks were provocative of a considerable amount of humour to the effect that the members in general did not want to hear what one another said, that the Press may be in a position to make more intelligent reports on the subjects discussed if they do not hear the members' remarks, and so on, there was an evident feeling that it would have been a real advantage if this room had more completely fulfilled the object for which it was designed, namely, a chamber where the members and visitors could hear one another in the discussion of the vital problems confronting our elected parliament. The strictures of Mr. Logan are very out-spoken, as for example quoting from Hansard, "Think of it! We have built a $12,000,000.00 building in which we cannot be heard. It is ridiculous. It is not fair. It is neither just to us nor to the people we represent."

At the close of the debate, Mr. King, of Kootenay, promised to have enquiries made during the recess with a view to seeing if it were possible to bring about the desired improvement. We have since seen a newspaper item, the accuracy of which we cannot vouch for, to the effect that it was proposed to set aside $50,000 to improve the acoustics of this room.

The construction industry is not so directly concerned with whether the members can hear one another, or whether they would be any better off if they did hear one another, as they are with the question "Whose fault is it that the acoustics of the Commons' Chamber is poor? On whose doorstep can the blame be placed? Must we as an industry that consiedrs itself as using modern and advanced methods of construction admit that when it comes to putting up a building of this kind we do not know how to do it?" This is not the only example of large and expensive buildings that have proven equally faulty in the matter of acoustics. Unfortunately we know of many churches and many music halls that are far from perfect in this respect. However, as an industry, should

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Canada's Engineers—Alexander Fraser

Alexander Fraser, associate chief engineer of the Roads Department of the Province of Quebec was born in the parish of Cap St. Ignace, Montmagny County, Que. He received his first education at the parish school and then at the college of Ste Anne de la Pocatiere where he won the degree of bachelor of arts. In 1905 Mr. Fraser took up the Civil Engineering course of the Montreal Polytechnique School from which he graduated in 1909 with the degree of bachelor of Applied Science and the diploma of Civil Engineer.

Upon leaving the university Mr. Fraser was engaged as assistant engineer on the engineering staff of the St. Lawrence Ship Channel, and remained until 1911. However, judging that the field in the line of work in which he was first engaged did not appear broad enough for his ambitions and seeing an opening to apply his knowledge in a work in which he had often thought he would succeed, Mr. Fraser resigned his position with the Dominion Government in 1911 to accept another with the Quebec roads department as assistant engineer on the construction of the King Edward VII highway between Montreal and Quebec, which position he filled during the two following years. In 1914 he was given complete charge of the western division of the great highway, and in 1916 was appointed associate chief engineer of the department, which position he still occupies and in which the services that he hoped to render to his province in his favored line of work, were widely realized, judging by the amount and quality of the work that has been done under his direction since he first entered the department.

Mr. A. Fraser

Mr. Fraser is a member of the Association of Professional Engineers of the Province of Quebec.

we not feel ashamed when, after constructing a beautiful building like our Ottawa Parliament Building, it fails so miserably to fulfill the purpose for which it was designed?

We are not going to pass an opinion as to the person or persons at fault. The principles of acoustics are well-known. Almost as much attention is paid to the teaching of this subject in our universities as is given over to architecture or design. Yet the fact remains that we can build a beautiful building, but we cannot design a building with the assurance that speakers can be heard in it.

This is surely a matter that should be taken up forthwith by the construction industry. If the contractor is supposed to have a knowledge of acoustics and has not this knowledge, that defect should be remedied. If the architect is supposed to have a knowledge of acoustics, and has not that knowledge, this should be immediately added to his educational curriculum. If neither of these is supposed to have an intimate knowledge of acoustics, this fact should also be recognized and acoustical experts or engineers should be developed. For $50,000.00, the university could well afford to establish a department and turn out acoustical experts, if these are not available at present. We suggest this subject as a fruitful source of discussion between the architects and the contractors at an early joint meeting.

The expenditure of $50,000.00 to improve the acoustical properties of the Commons' Chamber at Ottawa places the building industry in a ridiculous position. Who can guarantee that conditions will be any better after this money is spent? Is our industry merely in the experimental stages, or do we definitely know our business?

Contract News

The Deslauriers Metal Products Co., requested by H. A. J. Aldington, 1977 Queen St. E., Toronto, have secured contracts for supplying steel forms for concrete columns for the following: P. L. Robertson Co's factory, at Milton, Ont., for which the Pigott-Healy Construction Co. are contractors; the Hydro-Electric office building, Hamilton, Ont., for which the Pigott-Healy Construction Co. are also contractors and the Harris abattoir, Toronto, for which Wells & Gray Ltd. are the contractors. Mr. Aldington has also secured additional contracts for road reinforcement for a highway at Mimico, Ont., E. C. Hoffman being the contractor.

The Canadian Benedict Stone Co., represented by Mr. Aldington, have received contracts for the stone work on the new Bell Telephone Co's. exchange at Main St. and Kingston Rd., Toronto, and on the E. R. Wood residence, Toronto. In connection with the new Durant Motors factory at Leaside, Ont., the partition tile has been awarded to the Erie Clay Products Co., Port Dover, Ont., whose agent is Mr. Aldington.

This Week's Meeting of the Toronto Branch, E. I. C.

The weekly meeting of the Toronto Branch of the Engineering Institute of Canada, on Thursday evening, Nov. 2, at the Engineer's Club, will be addressed by Prof. O. W. Ellis, on "Some Points of Contact Between Metallurgy and Engineering."

The New Highland Creek Highway Bridge

A 655 ft. Steel Structure Crosses Deep Ravine on the Kingston Road, East of Toronto, Ont., and Eliminates Dangerous Grades—Road Diverted to Shorten Bridge—Details of the Design

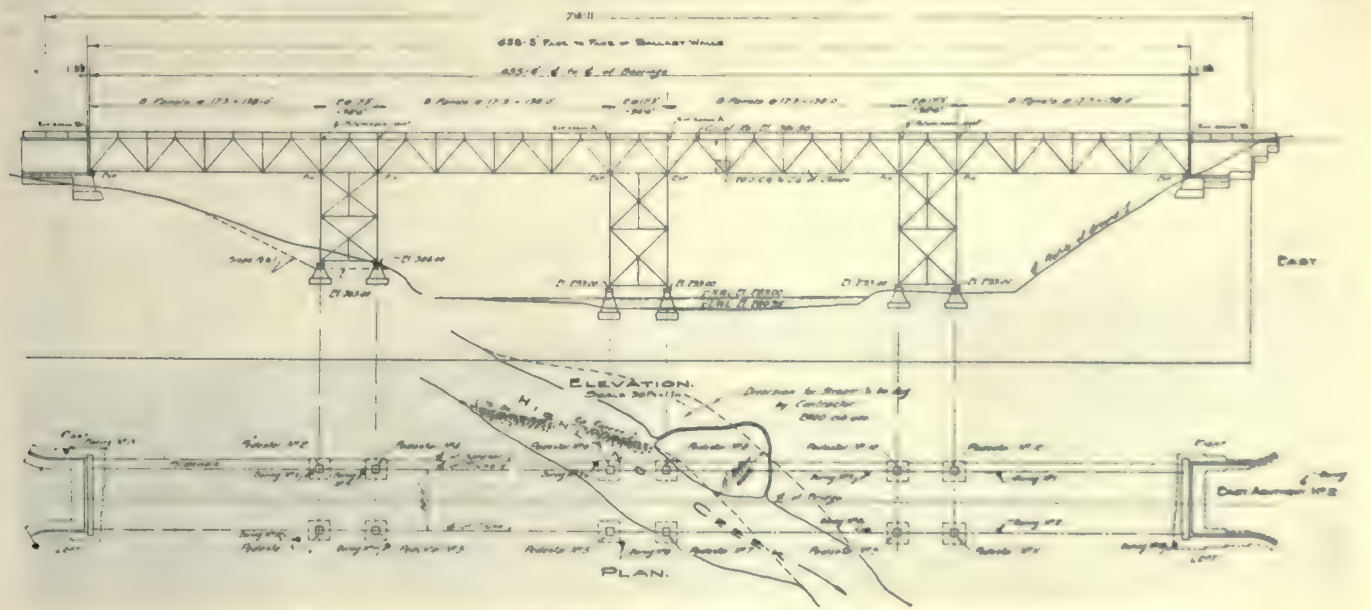
By A. B. CREALOCK, B.A.Sc.
Bridge Engineer, Ontario Department of Public Highways

Among the many improvements carried out in the rebuilding of the Kingston Road running east from Toronto, Ont., the new bridge at Highland Creek, which will shortly be opened to traffic, is one of the most outstanding. It has been the policy of the Ontario Department of Public Highways to remove, to as great an extent as possible, the danger points on the roads. The present crossing of Highland Creek is one of these danger points and great interest is evidenced in the construction of the new high level bridge at this point.

Highland Creek is situated about fifteen miles from Bloor and Yonge Streets, Toronto, and although a small stream at the present time, it lies at the bottom of a deep valley. The descent to this valley on the west side has a drop of 67 feet in a distance of 750 feet giving a grade of almost 9 per cent. From this point the road crosses the valley on practically a level grade for a distance of 1,200 feet. Here the grade rises again and 200 feet up the bank crosses over the creek on a narrow bridge. This structure is of interest in that originally it was a steel truss. When it was found necessary to rebuild, a concrete truss was poured using the old steel truss as a base for the forms. The grade on the east bank has a total rise of 84 feet in a distance of 1,300 feet. The grade however, is not uniform and for the greater portion of this bank the grade is over 10 per cent.

With the narrow roadway and excessive grades that exist at this crossing it is easily seen that the old road is a dangerous one to travel. In the winter season when the ground is covered with snow and ice the danger is increased and several accidents have occurred. At the present time the handrail on the bridge bears mute testimony regarding an accident in which a car was badly wrecked.

The crossing at the present location is 3,500 feet from the top of the west bank to the top of the east bank. To bridge or fill this gap to provide a high level crossing was out of the question, and the Department Surveyors have laid out a diversion with a length of 6,250 feet between the two intersections


714'-11"
658'-5" Face to Face of Ballast Walls
655'-6" ℄ to ℄ of Bearings
EAST
ELEVATION.
H I G H L A N D C R E E K
East Abutment No 2
PLAN.

Location plan and elevation of bridge

The new Highland Creek bridge eliminates a bad crossing on the Kingston road just east of Toronto, Ont.

with the Kingston Road. This new line which is 500 feet longer than the old line, is 1,300 feet south of the old road at the farthest point. The maximum grade on the line is 2% and this extends for a distance of only 400 feet. By using this line we are enabled to cross the valley with a bridge that is 655 feet 6 inches centre to centre of end bearings and a fill, 200 feet long, behind the west abutment.

The plans for this structure were prepared by the Department in the opening months of the present year and tenders were called for the construction of the bridge during the month of February. Contractors for the superstructures were asked to bid on two designs—one with a roadway 30 feet in clear width and two sidewalks each six feet in width, and the other with a roadway 35 feet 6 inches in clear width and one sidewalk 6 feet wide. Each of the above designs were deck type structures with a clear distance of 42 feet between the inside edges of the handrails. When the tenders were received it was decided to accept the design with one sidewalk as the extra width of roadway appeared to be more desirable than having two sidewalks. In tendering the bridge companies were asked to submit their own stress sheets. All important details and essential dimensions were laid down by the Department and suggestions were made with respect to the most acceptable material for the various members.

Details of Design

The bridge is made up of 4 long spans and 3 tower spans. The long spans are Warren trusses with 4 panels of 34 feet 6 inches making a total length of 138 feet centre to centre of bearings. The floor beams occur at every intersection, thus giving a stringer length of 17 feet 3 inches. The tower spans are made up of a single truss of two panels, each 17 feet 3 inches. All trusses have a depth of 20 feet between the centres of gravity of the two chords. The stresses in the members of the trusses were exceedingly high for a purely highway bridge, the heaviest section in the top chord being composed of a plate 19″ x 5/8″ and two 15 inch I-beams at 70 pounds. The other section of the top chord was composed of a plate 19″ x 5/8″ and two 15 inch channels at 50 pounds. The other sections of the truss were also of heavy material, the central section of the lower chord being composed of 4 angles 8″ x 3-1/2″ x 13/16″ and a plate 9″ x 3/4″. The stringers are 12″ I-beams at 31.8 pounds and are spaced at 3 feet 2 inch centres. The trusses are placed under the curb on the roadway and are 34 feet 9 inches centre to centre. Due to the extreme width of the roadway the floor beams are designed to carry the full load of 2 twenty-ton rollers which resulted in a 30 inch Bethlehem girder beam at

This view shows how the stream was diverted around one of the towers. The bank was riprapped to prevent scour

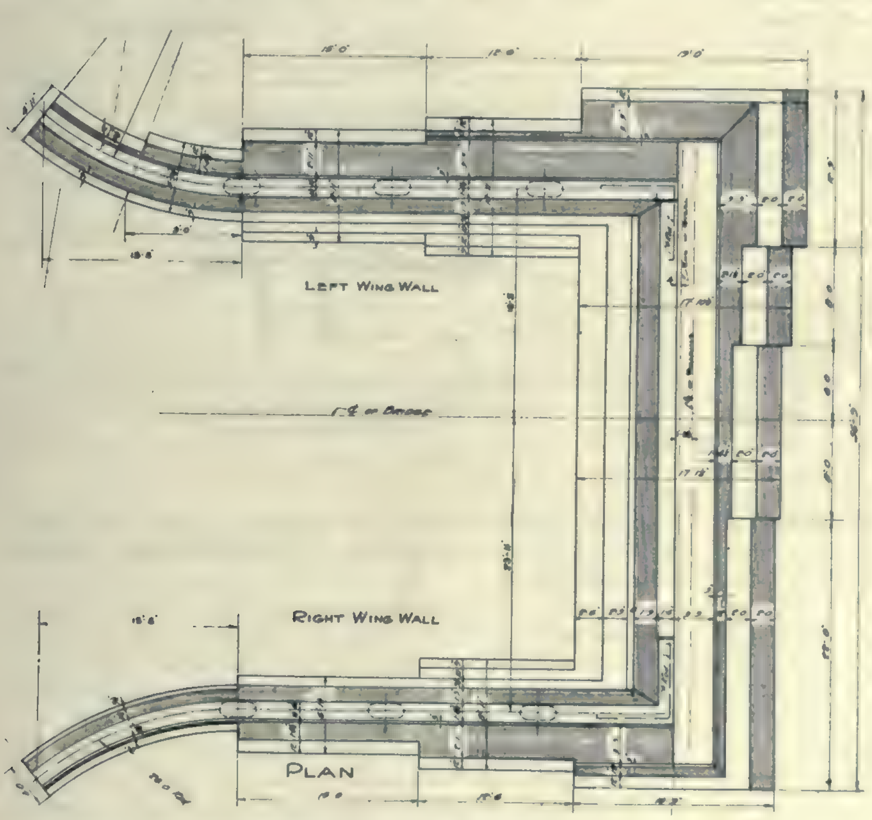
Two views of the new Highland Creek bridge

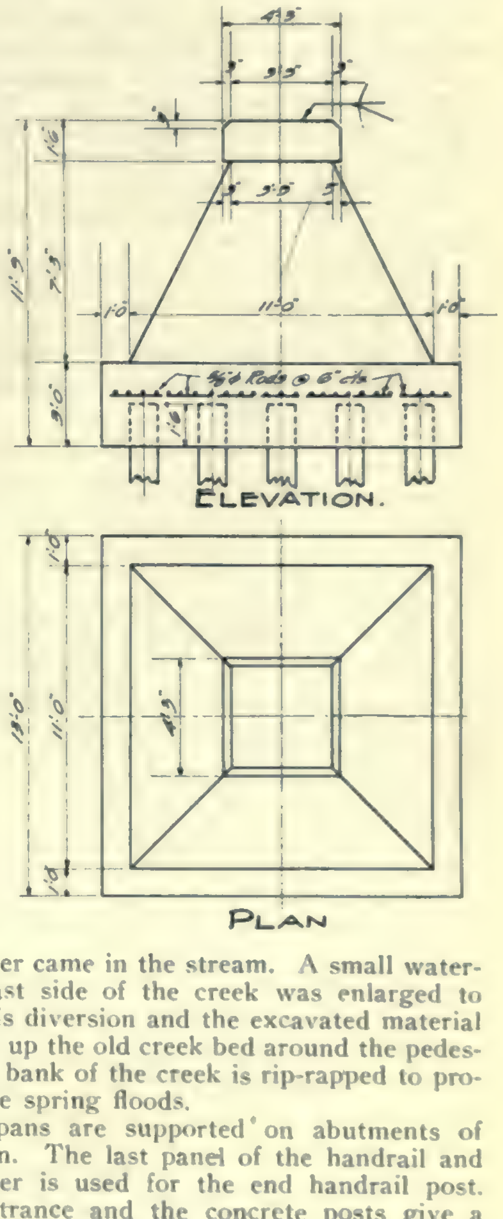
180 pounds. In this bridge the duplication of members would play an important part in speeding up the shop work. The truss members were 34 feet 6 inches long and on most of these the number required was sixteen. For the stringers the greatest number of duplications was 240. The total weight of the steel superstructure was 740 tons. The crown of road on the bridge is 100 feet 6 inches above the water level, and a beautiful view of the valley may be seen from the deck of the bridge.

The towers to carry the bridge were composed of 14 inch H sections at 138 pounds for the central and east tower. The west tower is part way up the bank and being somewhat shorter is composed of 14 inch H sections at 130.5 pounds. The free ends of the two central spans rest on bronze plates on the towers to allow for expansion. For the end spans the free ends rest on the abutments and are supported by four rollers of 5" diameter by 2' 8" long. The handrail is of the heavy construction used by the Department for this type of bridge. The top member is made by rivetting 2 angles 3" x 2" x 5/16" to form a tee with a 6 inch flange while the lacing is composed of angles 1-1/2" x 1-1/2" x 1/4" and bars 1-1/2" x 1/4". The handrail posts are 4" H-posts at 13.5 pounds and the handrail, where joined to the post, is covered by a neat splice plate which covers all unsightly connections. The handrail is rivetted throughout except where slotted to alllow for expansion at the ends of spans.

The loading used in the design of the bridge was the Department's Class "C" with the exception that the impact was taken at 10% for all parts of the structure. As the bridge is in the country and the sidewalk is placed for convenience and the safety of pedestrians no stresses due to live load on sidewalks were considered in the design of the trusses. The sidewalk bracket, stringers and floor were designed to hold the specified load of 100 pounds per square foot.

The towers are supported on concrete pedestals the top of which were placed well above the high water level. Borings were taken to test the foundations before the plans were prepared and these showed excellent footings. Pile foundations, however, were designed but it was not found necessary to pile any part of the structure. The material is a heavy, hard boulder clay, extremely difficult to remove and it is very doubtful if a pile could be driven into it.





Above: Plan of abutment, showing curved wing walls. Right: Plan and elevation of a typical footing

Stream Diverted

In order to have a symmetrical bridge it was necessary to divert the stream as one of the pedestals on the central tower came in the stream. A small waterway on the east side of the creek was enlarged to take care of this diversion and the excavated material was used to fill up the old creek bed around the pedestals. The new bank of the creek is rip-rapped to protect it from the spring floods.

The end spans are supported on abutments of standard design. The last panel of the handrail and concrete pilaster is used for the end handrail post. This flared entrance and the concrete posts give a pleasing appearance to the bridge.

The deck of the structure is of concrete reinforced with expanded metal. The roadway slab is 7 inches thick at the edges and 8 inches at the centre. The roadway is crowned 2 inches, the extra inch being obtained by varying the heights of the stringers. The sidewalk slab is 4 inches in thickness and has a slope of 1/4 inch in 1 foot toward the curb for drainage. The surface of the walk is panelled and dotted. The deck of the bridge is drained by 2½ inch diameter pipes on each side of the road spaced at 17 foot 3 inch centres. On the roadway side a 12 inch channel is rivetted to the top chord to act as a form for the concrete while on the sidewalk side an angle, 4" x 3" x 1/4", serves the same purpose.

In pouring the floor the concrete was mixed at the east end of the bridge and hauled in buggies drawn by horses to the centre of the bridge. Pouring was started at the centre of the bridge and carried to the east abutment. The mixer was then removed to the other end of the bridge and the same operation repeated. At the free end of all spans steel expansion aprons, conforming to the crown on the road and slope on sidewalk and curb, are provided. Where these aprons rest on the abutments at the ends of the bridge a steel shoe is anchored in the concrete to carry the sliding plate. The concrete is broken by an elastite joint at all fixed ends of spans.

The following sequence of operations was followed in the construction of the bridge. These formed a part of both substructure and superstructure contracts and specified the work each contractor had to do and when it was to be done.

"The contractor is to be bound by the following sequence of operations.

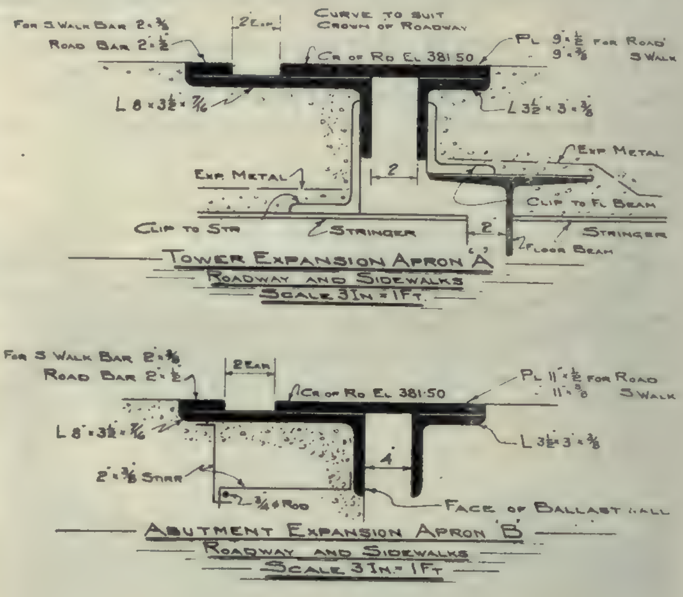
"(1) Substructure contractor will build abutments and wing walls to elevation of bridge seat, approximately el. 358.875, also build pedestals to finished elevation and set anchor bolts in pedestals with template as shown on substructure drawing; (to be completed June 1st, 1922.)

"(2) Superstructure contractor will then erect steel except handrail on wing walls, will drill and set anchor bolts on abutments. All rivet heads and rubbed spots are to be painted with red lead shop coat. No second or third coats of paint to be applied at this time.

"(3) Substructure contractor will then pour concrete floor and sidewalks on bridge, build ballast walls and wing walls and set steel shoes of expansion aprons. As wing walls are being finished superstructure contractor will rivet handrail so as to allow posts to be set in concrete. Substructure contractor will then clean entire superstructure so as to remove all concrete drippings from the steel work.

"(4) Superstructure contractor will paint all steelwork two field coats and clean concrete substructure of any spilt paint."

Work was started by the substructure contractor in April and the concrete work was ready for the steel before the date specified. Work of the erection of the steel superstructure was started on June 1st. While the steel was being erected the substructure contractor was busy with the diversion of the stream and with a certain amount of grading around the tower of the west bank. The pouring of the ballast and wing walls on the abutments and the deck of the bridge was started early in September, and at the present time this work is completed and the bridge is being painted. The grading of the diversion including the building of the necessary culverts is completed with the exception of the backfilling behind the abutments.

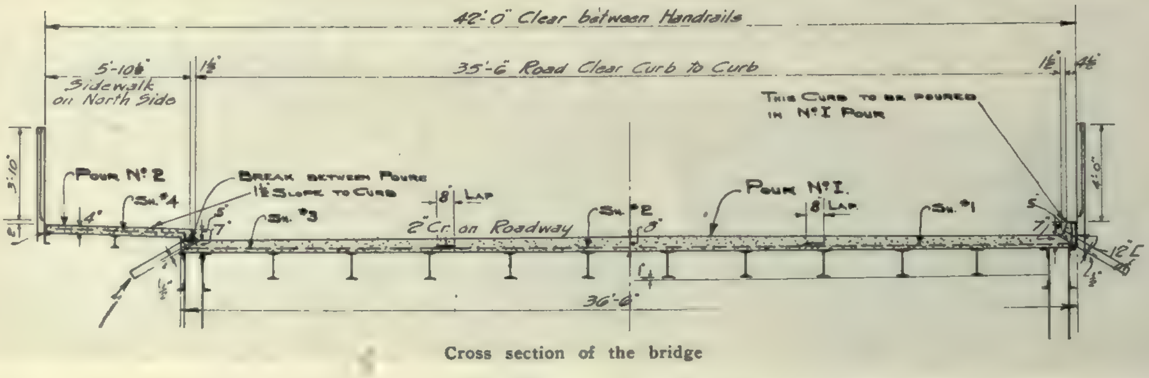


Details of expansion aprons

In order to facilitate the building of this bridge and the paving of the Kingston Road the Department have constructed a siding where the main line of the Grand Trunk Railway crosses the Kingston Road about 2 miles west of the bridge.

It is expected that the bridge will be open for traffic before the first of December so that it will not be necessary to use the old road this coming winter.

The contractors for this work were:—Steel superstructure, the Canadian Bridge Company Ltd. of Walkerville; substructure, the Ontario Bridge Company Ltd., Toronto; grading, Oliver Baskin of Norwood, Ont.



Cross section of the bridge

Town Planning Legislation Discussed

The Toronto Branch of the Engineering Institute of Canada Holds Meeting to Consider the Proposed Town Planning Act—Some Changes Suggested

The weekly meeting of the Toronto Branch of the Engineering Institue of Canada on October 26 was given over entirely to a discussion of the proposed bill to amend existing town planning legislation. This new bill was drafted by a committee appointed at the recent convention of the Ontario Town Planning and Housing Association in Toronto and the Ontario Government, in response to a request of the association, has appointed a committee to whom the draft bill will be presented.

Mr. W. S. B. Armstrong, secretary of the legislalative committee of the association, took the chair during the discussion, and in introducing the subject, stated that the difficulty in town planning has always been the wide division of counsel and the great need is the creation of agencies, both in the province and the municipality, which will give a leadership to municipal councils in town planning.

The Bureau of Town Planning

Mr. W. S. B. Armstrong, secretary of the legislation committee was then called upon and he briefly discussed the relationship of the bill to the urban municipalities. He explained the proposed changes in the supervision of town planning matters, as incorporated in the new bill and stated it was his belief that real progress along town planning lines depended largely on the setting up of such provincial authority as was suggested in the new bill, the Bureau of Town Planning. It is proposed in the bill that this Bureau be attached to one of the departments of public service and be under the direct control of the minister in charge of that department and shall have a director, appointed by the lieutenant-governor, to act as deputy-head of the department. The duties of the bureau, as set out in the draft bill, are as follows. It shall:

(a) Issue from time to time and send to the clerk of every municipality and secretary of every plan commission, bulletins dealing with town planning and housing activities, in order to secure co-operation and co-ordination between the various town planning authorities and developments in the province.

(b) Collect such statistical and other information respecting Town planning and housing affairs in Ontario as may be deemed necessary or expedient from time to time.

(c) Enquire into, consider and report upon the operation of town planning and housing laws in force in other provinces of the Dominion and in Great Britain and in any foreign country, and make such recommendations and suggestions thereon as may be deemed advisable.

(d) Prepare for the guidance of local authorities standard regulations required for the purpose of this Act.

(e) Upon request of any local authorities and where, in the opinion of the director, it is desirable so to do, provide such local authority the services of a town planning advisor, with such other assisting staff as may be arranged for, at such rate per diem as may be fixed for such services from time to time by the director.

(f) Receive in charge from. and hold at the call of the board, all plans and documents referring to town planning and land subdivisions, which are now or which later under any statute or order of the board, may or would be filed with the board.

(g) Advise the board on all matters coming before it under this act, or on other matters referred to it by the board.

(h) Prepare and transmit to the lieutenant-govenor in council annually a report upon the work of the bureau during the preceding year, together with such statistics and other information as may have been collected in the bureau.

(i) Perform such other duties as may from time to time be assigned to it by the lieutenant-governor-in-council.

The speaker referred to the organization for the supervision of community planning in England, where technical experts in their various lines, are entrusted with the supervising authority and pointed to the progress that has been made in that country.

Opposition From the Townships

Mr. H. E. Redman, solicitor for the township of Scarborough, was the next speaker, dealing with the proposed new legislation from the viewpoint of the urban centre. He saw some opposition to the bill from the townships, chiefly arising from the desire of the urban centres to maintain their independence and not be forced to become connected, through the town planning, with the larger municipalities. He agreed that co-operation was absolutely necessary between the city and the surrounding district in order to assure successful development, but was not in accord with the bill's provision which called for five members from the city and two from the surrounding district to constitute a local commission, when the majority of the planning would be in the township. This planning, owing to the city's majority representation on the commission would be controlled, he stated, by the city. He anticipated further difficulty in the increased financial strain which the townships would have to bear from enforced improvements and pointed out the present serious situation in financing school accommodation in some of the districts. Country people, he stated, were heartily in accord with planning, but the legislation would have to be very carefully worked out. Further points in the bill which were not clear to the speaker and in which he saw possible opposition were cleared up by Mr. T. D. LeMay, a member of the new legislation committee, later on in the evening.

Mr. Wilson then ran briefly through the bill and dealt in more detail with the advantages which the rural district derived from the proposed new legislation, which gave them a voice in the planning of their own districts, something they did not possess in the existing legislation. He also explained the proposed tax of one-tenth of a mill to be paid on the basis of assessment, as a town planning rate, to provide an annual stipend, a "bread and butter allowance" he termed it. for the commission which would mean, in the case of the city of Toronto, an annual allowance of $65,000. The commission would thus be able to capitalize up to one-half of their annual assured income over a debenture period of forty years, and would be enabled to carry out work of immediate importance in cases where municipal funds were not at the moment available.

Co-operation Necessary

Mr. George C Powell, deputy city engineer of Toronto, the next speaker, felt that the success of the town planning movement rested entirely on the amount of co-operation existing between the city and suburban districts. In the case of Toronto, large sums would be spent by the city he stated and this money would be for the ultimate good of the entire community, which fact, if it could be impressed upon and accepted by the rural authorities, would mean something accomplished towards the desired co-operation.

Mr. LeMay, the next speaker, did much in his short talk to enlighten many false interpretations placed upon various clauses in the new bill by its opponents. He also touched on the proposed planning tax of one-tenth of a mill, and when it was considered that the amount realized from this source in Toronto, approximately $65,000 annually, represented a fee for the proper supervision of the city's annual expenditure of $20,000,000 on public works and improvements, he felt that nobody could look upon the fee as unreasonable.

Mr. Redman made a few suggestions for changes in the bill which he felt would increase the likelihood of its acceptance by the government committee. He felt that the very complexity of the bill and the large number of subjects dealt with in it were obstacles to its success. He also thought the proposed long term issue for financing work, which virtually shifted the responsibility of payment to posterity, would meet with opposition from the government.

Mr. A. G. Dalzell, in proposing a vote of thanks to Messrs. Wilson, Armstrong, and Redman and the other members who took part in the discussion, stated that he thought the difficulty with town planning has been that the details have been in the past worked out by people who just copied the systems of other countries with no consideration for the conditions peculiar to this country. In England planning is a problem of congestion, while in Canada it is one of dispersion. He pointed to the situation in Nelson, B. C., where every street is 80 ft. wide with the exception of one which is 100 ft. Here the city owns half of its total area, involving too large a financial responsibility for development. He thought the new bill one of the best that has been drawn up, and attributed this to the fact that it had been prepared by capable men who knew local conditions. He urged engineers to interest themselves in this great problem of town planning.

Mr. Storrie, chairman of the local branch of the Institute, closed the meeting with a few remarks of thanks to the speakers and expressed himself in accord with Mr. Redman's suggestion of simplifying the bill as a means of enhancing its chances of success.

How Much Does it Cost to Run a Steam Shovel?

This question to be settled by Prize Contest announced by shovel manufacturer.

The Erie Steam Shovel Co. expects to render a real service to all contractors by getting together many actual maintenance cost records and publishing them in detail. To secure these actual records they have just announced a prize contest, prizes to be awarded for the best upkeep records. There are twenty prizes, ranging from one hundred dollars and a Waltham watch for first prize, fifty dollars and a Waltham watch for second prize, down to five dollars for twentieth prize. In addition five dollars will be given for every record that does not win a prize, but is published.

Contractors have from time to time accused equipment manufacturers of too much optimism in giving out figures on maintenance costs. The Erie Steam Shovel Company have always tried to use a great deal of restraint in publishing upkeep records, to avoid leading steam Shivel owners generally to expect too much accomplishment with only an average field organization—and now they propose to remove all doubt about actual upkeep costs.

The judges of the contest will be Arthur S. Bent, of Bent Bros., the well-known contracting firm of Los Angeles, Calif., Halbert P. Gillette, editor of "Engineering & Contracting" and author of the "Handbook on Excavation Costs" and many other works on costs; and A. C. Vicary, Vice-president of the Erie Steam Shovel Co., a mechanical engineer with many years of specialized experience on steam shovel work.

The prize contest opens this week and continues until December 31st. Records may be sent in by steam shovel owners, managers, or any employee in direct contact with steam shovel work. In every case, however, the record must be accompanied by a written statement from the owner of the machine to the effect that the figures submitted are correct to the best of his knowledge. The record should include approximate number of days the machine has worked, yardage moved, and class of materials, and all upkeep costs exclusive of cable, dipper teeth and grate bars. Complete information concerning this contest can be secured from the Erie Steam Shovel Company.

Correction

In our issue of October 4, Contracts Department, we stated that contracts for the Dominion Government at Grondines, Que., and Pourpore, Que., had been awarded to "Doran & Devlin," which should have read to "Doran Construction Company, Ltd."

A conference was held recently in Chicago with the President of the American Specification Institute and the possibilities of standard specifications for workmanship in frame construction were discussed. It is of importance to the lumber industry to take an active interest in having proper specifications, and in this work with the American Specification Institute, the National Lumber Manufacturers' Association hopes to develop a better type of architectural specification—at least a better type of those sections involving workmanship in lumber framing.

Inter-Provincial Good Roads Conference

Representatives of the Governments and of Highway Organizations Meet in Montreal and Quebec—Ask for Extended Federal Grants—Maintenance Assistance

Important resolutions, among them one asking further federal aid for the provincial highways amounting to $20,000,000, were adopted and matters affecting roads in all parts of Canada were discussed at the Inter-Provincial Good Roads Conference which was opened on Oct. 19, under the auspices of the Canadian Good Roads Association in the Old Colony Club, Montreal.

Representatives of the various provincial governments were present, Hon. J. L. Perron, minister of roads in the Quebec government, being in the chair, with Mr. George McNamee as secretary. Mr. Perron, who is also president of the Canadian Good Roads Association, welcomed the delegates and stated that he personally, and the Province of Quebec, felt greatly honored at having such an important conference held there.

Mr. S. L. Squire, chairman of the executive of the Canadian Good Roads Association, reviewed federal aid from various angles, presented data gathered by the association during visits of representatives of their body to the various provinces during the past year, and submitted a resolution of the association, passed in annual convention, supporting the principal of federal aid to the provinces, and advocating a continuance thereof.

Federal Grant of $20,000,000

The meeting promptly took up discussion of the various matters on the programme, and during the morning session the following resolution was adopted:

"That this conference favors further federal aid to the provinces in the matter of highway construction, and favors that Chapter 54 of the Statutes of 1919-9, 10 George V., entitled the Canada Highways Act, be amended so as to place a further sum of $20,000,000 at the disposal of the provinces."

The following matters were thoroughly discussed:

Federal aid—Should an extension of time be given provinces which will be unable to earn the total appropriation at expiration of time limit? Should there be further aid to the provinces at expiration of present appropriations; if so, what amount should be asked? What modifications should be made to the present regulations? Should federal aid be available for secondary roads? Should federal aid apply to bridges? Should federal aid be available for through roads in urban centres? If so, what class of urban centre? Should federal aid apply for maintenance? Should federal aid be restricted to types or a minimum cost of construction? Should federal aid apply on preliminary work, engineering, right of way, etc.? Should progress payments be arranged for.

Maintenance—Comparative methods.

Vehicular traffic (motor cars)—Uniform regulations; reciprocity of licenses, etc., governing commercial vehicles; maximum weights, widths, lengths, and speeds; trailers, semi-trailers, trains and autobus traffic; speed of heavy passenger vehicles; restriction of traffic and loads during certain seasons.

Vehicular traffic (horsedrawn)—Lights at night; width of tires; weights.

Comparison of provincial motor taxes—Autobus, truck and passenger cars.

Safety on the highways—Methods of enforcing speed and other regulations; grade crossings; headlights; danger signs—Government control of; regulation of advertising signs.

Trans-Canada highway—Is it in the interest of highway development to favor a trans-Canada highway? If so, in what manner should the same be advocated.

Profit from improved highways—Tourist traffic; co-operative effort to secure same.

Highway Maintenance

It was also resolved, that paragraph 2 of section 7, of the regulations of the governor-in-council, relating to federal aid for highways, be so amended as will allow the commissioner of highways in special cases to approve of the cost of a culvert over twenty feet in length being included provided the cost of any such culvert shall not exceed the sum of $10,000.

Another resolution was to the effect that progress payments of federal aid money be made immediately on the receipt of a report from the federal inspecting highway engineer.

A discussion took place in reference to highway maintenance, and various methods governing same,. In this connection the chairman, Mr. Perron, stated that the Good Roads Association was at the present time gathering data from the various provinces covering this work and that the information would be compiled and distributed as soon as completed.

A dinner was tendered to the provincial delegates by the Hon. Mr. Perron at the Windsor Hotel, and at 9 o'clock the second session of the conference took place for a resumption of the programme subjects.

The party left on Oct. 20 for a drive over the Montreal-Quebec highway, concluding the conference at the Chateau Frontenac on Saturday morning, after which the party entrained for Toronto, where they will be the guests of the Hon. F. C. Biggs for a tour of inspection over Ontario highways.

At the Quebec session the various items on the agenda were discussed, among these being the coordination of roads in each province and the question of autonomy which was taken up in the following resolution, moved by Hon. F. C. Biggs, minister of highways of Ontario and which was adopted:

"That this conference go on record as approving the principle of Provincial autonomy in matters of road building that in selection of routes on roads to be approved, same to be made with the following objects in view, 1st, local service; 2nd, by eventually co-ordinating the roads within provinces that the system when completed may form a comprehensive whole and the inter-provincial roads connection be made part of such plan."

Before the close of the sitting the members of the Conference went on record asking that efforts be made to try and have the International Good Roads Congress held in Canada. An invitation was also received from the city of Hamilton asking that the Inter-provincial meeting be held there next year. This matter was left aside for further consideration.

The following were the provincial delegates who attended the sessions: Prince Edward Island, Hon. C. W. Crosby, minister of public works, H. H. Shaw, chief engineer; Nova Scotia, Hon. H. H. Wickwire, minister of highways, A. S. MacMillan, chairman of the Provincial Highways' Board; New Brunswick, Hon. P. J. Veniot, minister of public works, B. M. Hill, provincial highway engineer, T. P, Regan; Quebec, Hon. J. L. Perron, minister of roads, J. L. Boulanger, deputy minister of roads, H. M. Necker, chief engineer; Ontario, Hon. F. C. Biggs, minister of highways, W. A. McLean, deputy minister of highways, G. C. Parker, secretary, highways department; Manitoba, A. McGillivray, chairman, Provincial Good Roads Board; Alberta, Hon. Alex. Ross, minister of public works.

The following represented the Canadian Good Roads' Association executive committee: S. L. Squire, chairman, Hon. J. L. Perron, Wm. Findlay, Russell T Kelley, J. A. Duchastel and Geo. A. McNamee.

Plastering is Not Up to a High Standard

Editor, Contract Record:

The writer was very much interested in Mr. E. J. Curry's answer to the article published in the Contract Record of May 10, entitled "Is Plaster Always Properly Sanded" Mr. Curry states that in his opinion the day of hand made mortar is gone, and anyone closely allied with the plastering trade will readily admit that his statement is substantially correct. If it were not for the extreme laxity of supervision of the plastering trade in the city of Toronto I believe that 95% of the material used would be prepared by the manufacturer.

The city of Toronto is known as a "lime city" and the greater part of the plaster used there is made from lump lime but it is a fallacy to believe that lump lime as it is ordinarily slaked and used produces good mortar either for plastering or brick work. We believe that the architectural profession and the architect's department of the city of Toronto have in their possession data which proves beyond a doubt that air slaked lump lime when used to lay up brick on certain jobs has proved very disastrous.

The slaking of lime is an operation which is almost invariably carried on by laborers who have little or no conception of the importance of their task. As a result many failures have been charged to lime in the past which actually were due to improper preparation during the slaking operation. If the lump lime or other plastering materials put on the job were as rigidly tested as cement, for instance, or plumbing fixtures, etc., the status of plastering would be immediately raised because this inspection would eliminate to a considerable extent the present use of air slaked lime and all lime which is full of impurities, etc.

As the writer in the May 10th issue of the Contract Record pointed out, the city architect's department very rigidly inspects all plumbing, concrete work, electric wiring, framing, masonry, etc., but pays no attention whatsoever to the plastering, and the consequence is that the majority of plaster used is grossly oversanded, and is made of very inferior materials. The sand used by the plasterer who is working for the speculative builder is of inferior quality and is generally dug out of the cellar. In our humble opinion a great deal of good can be done to the building trade in general, and the plastering trade in particular, if rigid inspection of both materials and workmanship were put in force by the city authorities.

Plastering is one of the oldest known arts and it is indeed a shame to think that this trade should be in its present state due to the fact that most plastering contractors use the wrong method. It is within the power of the plastering trade in general to rectify their mistakes and to cease using materials which are not standard and also to stop taking on contracts which would not make them one dollar unless they skimped the job.

Of course, all plasterers are not in this category as a great many of them use materials as they are supposed to be used and will not under any consideration use lump line. These men insist on using either hydrated lime, gypsum hardwall plaster or sanded hardwall plaster and have won for themselves enviable reputations. They can at all times command a good price for their labor and the persons for whom they work are guaranteed a good job.

Would it not be better if all plasterers were on the same basis and the unfair competition now in existence was eliminated by the simple process of using good materials as they are supposed to be used? The remedy in so far as the city of Toronto is concerned is a staff of inspectors working from the city architect's department who will give the same care and attention to the use of plaster as they do to other trades and we think the builders in general, and the architectural profession in particular, would be very pleased indeed to see this put into effect.

If the owner or the general public were fully conversant with the importance of his walls and ceilings he certainly would not stand for the material which is now applied to them in most cases, but would insist on good goods.

Yours truly,
J. F. Cameron
Sales Department
Ontario Gypsum Co.

Paris, Ont., Oct. 20

Limitations of Spreader Type Ditchers

Ditching machines of the spreader type will dress up a ditch nicely if conditions are exactly right; but conditions must be ideal; that is, the cut must be just wide enough and deep enough, and the soil not too hard. If the cut is shallow the material will pile up along the top and be washed back by the first rain. If the cut is too wide practically the same thing happens—the material flowing around the end of the wings and piling up a ridge in the cut. If the cut is narrow the machines can not be used at all. If the material is hard clay the machine will not cut it. It will not ditch around cattle guards, telegraph poles, stumps or other obstructions.

The Merits of the Quantity Survey System

An Argument Prepared by the Committee on Quantity Survey of the Society of Constructors of Federal Buildings (U.S.) —The Defects of the Present System

That the quantity survey, as a system, has great merit is conceded by all interested in the building industry, but its general adoption in this country has been delayed by several causes, one of which, the World War, resulted in a necessary suspension of all building activities. Of other reasons assigned for the delay in its adoption may be mentioned the dubious attitude of some who imagine that a new, and, as they say, non-producing factor is to be added to the industry: the query, "Who will assume the burden of cost?" is propounded.

The apparent reluctance to abandon old methods, admitted to be faulty, is being dispelled, however, as knowledge of the quantity survey becomes assimilated.

A quantity survey has been defined as a comprehensive and systematically prepared schedule of all the materials to be incorporated in a structure—the result of a thorough survey and check of the required drawings and specifications by highly-trained technical men.

A Uniform Basis of Bidding

The most important purpose of a quantity survey is that of rendering on the same basis as to quantities all bids of the competitors for the work. Thus, in formulating his bid, the competitor has only to append to the material costs, his labor costs, "overhead," profits, etc., which may be applied by the unit system or otherwise.

These schedules are so prepared that contractors or others interested may readily determine the character and value of any article indicated. Such indications are graphic descriptions, supplemented by measurements and diagrams if necessary, but in no case are they to be used in lieu of the drawing and full size details from which to execute the work.

Some opponents have thoughtlessly condemned the system on the ground that inaccuracies may occur. An indemnifying bond as a guarantee of accuracy has been suggested. "By their fruits ye shall know them." An architect does not guarantee the stability of a building, but he certainly suffers a loss in the event of any failure of construction.

The functional interdependence of a careful survey of quantities and a thorough check of the survey is a feature of the proposed system. The possibility of error is reduced to the minimum. What of the probability of error under the present system? How often is the success of a competitor attributable solely to error in taking off quantities? It may be said that absolute perfection will not be attained, but it is reasonable to assume that the element of error will be no greater than that of any survey made in the office of the contractor under the usual unfavorable conditions under which most estimates are made.

In some public work the bidders are required to check the schedules, and are afforded an opportunity to make provision in their proposals for any inaccuracies which may have been disclosed, though in general practice all proposals are to be based upon the schedules as submitted to the bidders and the low bidder will be permitted to have such adjustments as may be required after acceptance of the contract.

For obvious reason, adjustments before the award of contract are not generally advocated, but any antagonism due to this fact can readily be dispelled. These adjustments can certainly be made after the award of contract. The bidder is assured of a foundation, not otherwise procurable, upon which he can build a proposal.

In some instances purchases of the materials are made and bids for labor only are required. If after the surveyor's check inaccuracies still remain, and it is discovered during construction or after completion that the scheduled quantities upon which the labor bids were based were either inadequate or in excess of the requirements, then the adjustments for the labor can be made.

These applications of the system are cited to show that no interests can be jeopardized by the fact that a quantity survey may lack perfection.

Accuracy Guarantee

It is now possible to obtain, with a quantity survey, a guarantee of the accuracy of same to within a small percentage of the total sum involved. The contractor may assume this differential by omitting it and the cost of the indemnity as components of his bid, or he may transmit them to the owner. With the view of maintaining at the minimum the cost of the quantity survey, some advocates assert that a guarantee of accuracy necessarily involves an additional cost and an element of chance for which some interest must pay, and, furthermore, is superfluous if the system is properly applied.

Due to the diverse methods of estimating employed, there really exists in connection with the present system of contract awards a competition in the quantities of materials involved by construction work. To eliminate this quantity competition is a function of the quantity survey, and thus is simplified the whole matter of competition. The intent of the drawings and specifications may be in some respects quite vague and ambiguities may exist, but to this can be attributed only a very small percentage of the wide variances of the material bills as ascertained by different estimators. The quantity survey clarifies, and every bidder commences work on his proposal with the satisfying knowledge that the entire job has been carefully examined and that ambiguities which otherwise might have been costly have been eliminated; also that every other competitor, for his guidance in making up his bid, has been supplied with the identical information with which he himself has been provided.

Reducing the Hazard

The necessity for improvement of methods has long been felt, and such need is emphasized by the contractor's wail that instead of engaging in a business he is playing a most hazardous game. In any discussion of a contractor's business you will hear the assertion that the business is a gamble, that profits cannot be assured, and that a contractor's hope of salvation is that from some future work an abnormal profit can be derived which will compensate or over-balance the losses sustained on work which has been performed. This is a frank admission and is indicative of an unhealthy condition which certainly calls for the administration of some treatment. Primarily, competition will not permit a realization of the hope for large profits. The uncertainty of chance must be eliminated, or at least reduced to a minimum not in excess of that of any other business.

In order to procure the necessary volume of work, it must all be on a close margin; and it is seldom, if ever, that a contractor can withstand a loss.

As diagnosed by most authorities, the fault is with the contractor himself, and consists of blindly following precedent, employing methods some of which are now obsolete and others which never had any valid reason for existence; in numbers of cases there is an absolute failure to acquire the requisite knowledge of the materials to be furnished and the work to be performed.

A contractor sustaining losses is prone to communicate them to others with whom he is in contact, and it is thus that the whole industry is rendered ill and in need of a remedy.

Provide for Overhead

In addition to a profit on his material and labor costs, a contractor is entitled to a reasonable margin on his operating costs, inclusive of his own salary and the costs of estimating with other office expenses. In every proposal should also be given due consideration to depreciation on plant and equipment, interest on borrowed capital, taxes, and losses through bad accounts. If the business is to endure, such business principles cannot be ignored or laid aside for the gambling methods, and the contractor who is habitually remiss in making up his bid and who applies his prices and profits by the rule of guess can not find salvation in the quantity survey system, as, through force of habit, he will continue his rule of guess practices and eventually be self-effaced. The contractor who excels in management is an advocate of the quantity survey system.

It has been said that the surveys could not be satisfactory, as no two estimators employ the same methods, and that the contractor, whose business it has always been, is as capable of preparing a survey as any other person. Granting the truth of these statements, the fact remains that the one official survey, prepared by one or more surveyors, would govern any competition. There can be but one survey of any project. If it were otherwise, it is apparent that the present chaotic conditions would be but little improved.

Must be Official

The profession of quantity surveyor and the surveys must be inseparably linked with the word "official" by virtue of license by the owner or architect. The institution of the system and its operation does not, as some suppose, provide a wide field of operation for competing surveyors, who will sell their products to the contractors. In some instances, contractors' associations have established survey bureaus from which could be procured uniform surveys of any desired project, but it is to be noted that even in this connection uniformity is the very essence of the matter.

The survey, in conjunction with the unit rates of the proposal, has a value which will be appreciated by the owner and architect.

The uncertainty of chance being eliminated from the business of the contractor, the owner need no longer fear the possibility of being compelled to assume this chance in some degree unknown.

As in any sound business arrangement, the owner, who corresponds to the consumer, must assume the costs of estimating or overhead of the vendor, the contractor.

Eliminate the Waste

Confronted as we are at the present time by the greatly increased costs of all commodities, which may or may not have reached the peak of their ascension, it has obviously become necessary to eliminate from all transactions, so far as may be possible or practicable, every source of extravagance or waste.

Of the various industries none has been more severely affected or feels more acutely the necessity for relief in some form than building.

With the exorbitant costs of raw materials on the one hand and of labor, skilled or otherwise, necessary to shape them into finished structures on the other, together in many instances with excessive profits or commissions being exacted by distributors and contractors, the tentative builder of limited resources, who may not hope to protect his investment by correspondingly increased rentals, is driven entirely out of the market and the field is largely restricted to investors of unlimited means.

As it is upon the former class of investor that the industry must depend to a very large extent after the immediate demand for mercantile, public and semi-public structures shall have been satisfied, it is apparent that for the best interests of all concerned every effort should be exerted toward bringing the expenses within the limits of his means.

For relief, as concerns material and labor costs, we must apparently wait until the law of supply and demand shall ultimately lower or stabilize these, but, in the meantime, it is certain that an appreciable effect may be realized through the adoption of other more efficient business methods and procedure than now obtain, by which the added or "overhead" expenses of operation and administration would be in a measure curtailed.

The System at Present in Vogue

For instance, by the system generally in vogue at the present time, the drawings and specifications for a proposed building project go into the offices of the various contractors from whom competitive bids are being solicited, in each of which separate estimates may be prepared in more or less detail and with varying degrees or accuracy, according as errors occur in "taking off," etc., or different interpretations of requirements are assumed; also the limited time allowed generally precludes even a cursory checking.

The above, of course, takes no account of that class of contractors referred to above whose estimates, being the result of a general scanning of the work contemplated and a comparison with a similar structure previously built, are only too often disastrous both to themselves and their patrons, which practice will inevitably eliminate them in time from the field.

Experience has shown that an estimate prepared with any degree of accuracy will generally range in cost between one-half of 1 per cent. to 1½ per cent. of the actual cost of the finished work.

Assuming that in the manner prescribed above estimates have been prepared by six competitors, the process has been duplicated six times, which, taking the lower of the above limits, brings the total expenditure for estimating the job in question up to 3 per cent. of its cost, and, under certain conditions, may reach 9 or 10 per cent., or proportionately more as the number of bidders increases.

Owner Pays for Duplicate Estimates

While at first sight it may not be apparent to the layman builder that he is paying practically the entire cost of estimating his job, both by the successful and unsuccessful bidders, if he will consider the fact that the operating and overhead expenses of every contracting concern include the cost of all estimates prepared both for work obtained and work lost to other bidders, and are prorated against and defrayed by the enterprises in which they are the successful bidders, he will at once realize that the estimate submitted for his particular job embraces on the above-cited basis a pro rata of the entire operating expense of the concern, which would by the law of averages very nearly approximate the above-given total cost of estimates on this job. Data compiled for this purpose has shown that the average contracting firm figures from 8 to 10 jobs to every one that they obtain; consequently, that one carries the estimating cost of six or more.

It will, therefore, be seen that elimination of this duplication in the taking off or surveying of projects must of necessity produce an appreciable saving in incidental expense.

This elimination of duplication is one of the advantages to be realized from a general adoption by the building world of the quantity survey system.

Probably the chief difficulty in securing the adoption of this system is that of convincing the owner that the added fee for the quantity surveyor, which may be paid either directly or through the architect, is in reality a saving in that under the quantity survey system he is paying for this service only once, while under the present practice (though it may not be apparent to him) it is paid proportionately to the number of bids taken.

Knowledge of the quantity survey system is being disseminated by numerous mediums, and for the elimination of any prejudice which still exists a further campaign of education is required. We would express our appreciation of the privilege of participating in such campaign, in submitting this, the first of a contemplated series of papers on the advantages of the quantity survey system.

Are Large Reinforcing Bars Preferable to Small Bars?

A decade ago the detailer of reinforced concrete was governed by the maxim that steel reinforcement consisting of several small bars is preferable to that involving the use of a few large bars, states Chas. F. Reynolds in "Concrete." He further states that from the theoretical standpoint this may still be regarded as the best judgment of many engineers, but there are those however, who are among the users of loose bar systems, who prefer to obtain their required area of steel by the use of a few large bars as opposed to several small bars, a course which is held as more economical by those who adopt it. Advantages are naturally obtained by the use of either of the systems, a comparison of which it is here proposed to make. It will be assumed that ordinary commercial rounds are used in either case.

Mr. Reynolds first considers the subject from the designer's standpoint. With large bars, he has longer lengths available, and their use implies a reduction in the number of laps required, and avoidance of possible congestion of steel due to many overlaps. At the same time however, most designers are agreed that a more uniform resistance obtains throughout a section reinforced with bars close together, as in the case when small bars are used. Further, with a given depth of beam or slab, a slightly larger lever arm is obtained, hence a little less steel may be necessary, the area of which may be possibly more closely obtained by the use of small bars, since the interval between the areas obtained at practicable centres is smaller than with large bars. Less adhesion length per bar is necessary while smaller, and quite as effective, hooks and bends are required for small bars. In beam detailing the latter enables more bars to be bent up at convenient points for shear resistance, than is possible with the use of a few large bars.

From the contractor's point of view, however, it would seem that larger bars should be favored. Although larger bending and cutting machines may be required (though it is usual to have a variety of sizes on the site) and fewer bars can be handled at once, larger bars are cheaper to buy and are usually more expeditiously obtained, while labor costs are also cut by their judicious use. There are fewer bars to bend and fewer to handle. Their rigidity makes steel placing easier and there is much less misplacement through whippiness, nor are extra stiffening bars required. Distortion due to transit, or being trampled on by workmen is also avoided. Small bars are naturally easier to cut and bend (whereas large bars may require heating before bending), and can be bent when in position by hand-benders, but if left exposed for any length of time (which does occur despite specifications requiring the covering with cement wash of all exposed steel) pitting with rust more seriously reduced the effective area of each individual rod.

It is a foregone conclusion, however, that the subject resolves itself into a contest of theory vs. practice, and since the latter is in this case the economical standpoint (assuming of course that theory is not disregarded sufficiently to imperil the safety of the construction) the large bar system undoubtedly appears to be the more advantageous. A great deal depends on what structural member is being considered.

In Slab Systems

In slab construction the advantage accruing from the use of small bars may to a certain extent be obtained by the use of mesh or lattice reinforcements, but the controversy (if such exists) between the use of these patent methods and the loose bar type, is outside the province of this article. Confining our attention, however, to loose bar systems, consider the case of a slab 4 in. total thickness requiring .23 sq. in. of steel per foot width. This would be provided by either 5/16-in. diameter bars at 4 in. centres, 7/16 in. at 8 in., or ½ in. at 10 in. centres. Various regulations govern the extent to which the principle of using as large size of bar as possible can be applied. Thus the London County Council specify that the maximum spacing shall not exceed twice the effective depth. In a 4 in. slab having an effective depth of 3.25, the maximum spacing would be 6½ in., thus automatically fixing the size of bar at 3/8 in. diameter. In some respects the L.C.C. regulations are admittedly somewhat old-fashioned, and more economical would be ½ in. reinforcement at 10 in. centres in case where the main reinforcement is along both axes of the slab, or 7/16 in. at 8 in. centres, where it is in one direction only, with an efficient distributing system of light steel at right angles. The New York regulations would allow either of these sizes and spacings.

The sizes of main bars in beams are settled largely by the size (especially the width) of the beam. In small members to have a minimum of two bars in the bottom (although efficient detailing obtains by the use of one bar in top and bottom, as in light trimmer beams), is common, and when the number is thus specified, the size of the bar is automatically fixed, with usually ½ in. as a minimum diameter. In large beams a few larger bars are usually more convenient, as the comparative width of beam is not so great, and would probably necessitate two layers of small bars with consequent loss of lever arm and increased constructional difficulties. Large beam bars allow more ample space between them, allowing more efficient ramming of concrete.

Limitation of Stirrups

It is common knowledge that stirrups or beam bindings are expensive items to bend, and anything that can be done to decrease their number is worthy of consideration. Limitations are imposed for theoretical reasons on the spacing of these shear members, and it is a moot point whether it pays to alter the sizes of the buildings in order to attain the maximum spacing (usually the lever arm), and thus reduce the number of bindings to a minimum. Something in this direction may be done when the bulk of the shear can be taken on bent-up bars, and only a nominal amount left to the binding, which method produces a very economical design.

The main bars in columns are more or less fixed in number and hence their sizes are determined. Here, however, where four bars can be made to supplant six or eight smaller bars, the number of bindings are halved, as it is usual for one binder to secure four longitudinal bars only. In columns much scope is found for the application of the large bar principle. It is the opinion of many engineers, however, that the criterion of the strength of a direct compression member lies in the hooping and binding, and pursuing this idea, it follows that small expensive binders at close centres give a stronger member. If this view is held, spiral binding is found to be cheaper, but in light columns where such binding would not be economical the spacing should be as large as possible, up to a maximum equal to the effective width of the column.

It is contended from these few remarks that, without extensively violating theoretical principles, more economy accrues from the use of a few large reinforcing bars, than from an equal amount of steel, contained in several smaller bars.

Highways in Canada

There are now 1,000 miles of permanent paved roadways in Canada, or sufficient mileage to extend one-third of the distance between the Atlantic and Pacific coasts, according to A. W. Campbell, Dominion Highways Commissioner.

Activity in road-making has been general throughout the entire Dominion this year, according to Mr. Campbell, and on a larger scale than ever before. The total expenditure will be the largest of any year, and for the same amount of expenditure as in 1920, the amount of completed work will be fully 30 per cent. greater, owing to decreases in the prices of material and labor. Organizations in the various provinces have been completed, the development has been consistent and uniform in all the provinces, and as a consequence, about $15,000,000 will be spent on Federal-aided roads this year, of which $6,000,000 will come out of the Dominion treasury.

In addition to this outlay, there are large expenditures made by the provinces and counties on roads not receiving federal assistance, amounting to about $26,000,000 this year, bringing the total outlay on roads in Canada this year up to nearly $40,000,000.

New Series of National Association Publications

The National Lumber Manufacturers' Association has for some years been issuing separate publications, giving basic information on lumber and its uses, which have been cordially received by architects, engineers, builders, educational authorities, and others. The support given this phase of national activity has led to the conception of increased service and a new and more comprehensive series of publications. One of the aims of the new series will be the dissemination of data which, it is hoped, will result in establishing desirable basic standards with respect to the uses of wood in all types of construction.

The Association requests and will appreciate suggestions as to subjects and methods of treatment in order that such information as is issued may be most beneficial to all concerned. The first of this series of publications will probably be distributed during October.

The Department of Railways & Canals, Highways Branch, Ottawa, has issued a bulletin on Canadian highways and roads. It contains a summary of the experience of the department with roads, good and bad, in the provinces of the Dominion, and is full of information, not only for the men who build roads, but equally for the larger number who use them. This publication is entitled Bulletin No. 1, which indicates that other bulletins of this nature will be published from time to time. The introduction is signed by A. W. Campbell, chief commissioner of Canadian highways and roads.

The Canadian dollar is at a premium in every country in the world.

Direct Oxidation Sewage Purification

The Status of the Electrolytic Method of Treatment is Discussed in Two Papers Read at the Convention of the American Society for Municipal Improvements

By R. J. FULLER
Consulting Engineer, New York City

The use of electricity as a purifying agent has appealed and continues to appeal fascinatingly to the lay mind. For more than thirty years arrangements in which use is made of electricity have come up for consideration. The writer first became acquainted with the so-called "Webster process" of this type in London in 1890. In test plants this process was shown to be to a considerable extent a coagulating arrangement whereby electricity was used to decompose iron or aluminum electrodes, thus forming hydrates of these metals. The effective work was chiefly done in a manner more or less resembling the coagulating effect in water treatment plants in which use is made of sulphates of iron or alumina.

Undoubtedly there is some electrolytic decomposition of water even where iron and aluminum plates are used and bubbles of oxygen and hydrogen are released. Some of the oxygen is released in an atomic or anodic state whereby it has a high power for oxidizing even inert organic matter. Excessive cost has kept this process from general adoption.

The writer investigated the "Harris magneto-electric process" at Louisville at considerable length in 1897, but they did not offer reasonable prospects for practical success. Plants of this type were installed for sewage treatment at Santa Monica, Cal., Oklahoma City, and a few other places. Practical accomplishments were small and all of the plants have been abandoned except the one at Santa Monica which was found a year ago to be still in service under conditions greatly overtaxing its limits of effective performance.

Recent Developments

During the past ten years much attention has been given to improvements, made largely through the efforts of the Landreth Company of Philadelphia, by the introduction of revolving paddles between the electrodes to remove the gases which cause polarization. Use was made of lime, presumably at the outset to increase conductivity and to lessen the quantity of electricity used per unit area of electrode. The "Landreth electrolytic process" was installed some eight years ago at Elmhurst in the Borough of Queens, New York City. It was investigated at length by the city officials of New York, preparatory to deciding whether to adopt the process for other plants within the city limits, but no such plants have been installed. At Decatur, Ill., extensive investigations were undertaken shortly thereafter, but the process was not adopted and after a delay of some five or six years trickling filters are now being installed there.

The "Clark process" of the electrolytic type was devised and patented by J. M. Clark six or eight years ago, when it received some attention in New Jersey. The successor to this process is known as the "Selo method," which is somewhat similar to the "Landreth electrolytic process" except that in the "Selo method" there is separate treatment of the sludge, to which salt is added, and there are certain differences in plant details. By this method the sewage is dosed with milk of lime in an agitating tank, then settled in a circular tank having a Dorr thickener and passed through an electrolyzer. The sludge is mixed with a solution of salt and electrolyzed, disinfected and deodorized by the sodium hypochlorite which is formed by the use of electricity. It is claimed that the sludge is rendered drainable to 60 per cent moisture in 48 hours so that it may be used as a fertilizer.

A plant of the "Selo method" was installed several years ago by the Thermoid Rubber Co. at Trenton, N. J. It is understood that the electrolytic features of this plant added little or nothing to the quality of sewage effluent and it was found on a recent visit there that electrolyzers had been removed.

Direct Oxidation Process

The Landreth patents covering the so-called "direct oxidation process" are controlled by the Municipal Sewage Disposal Co. of Philadelphia, which has installed two plants, one at Phillipsburg, N. J., and another at Allentown, Pa. At Phillipsburg the plant has been in service for about two years and last spring an extensive set of tests was made by the State Department of Health but the results have not yet been made public. At Allentown a 3-m.g.d. plant at a cost of about $180,000 was installed and has been in intermittent service for nearly a year. Sanitary sewers in Allentown have been built only to a limited extent and it is understood that at present there are only about 700 sewer connections, which produce a volume of flow which permits the treatment plant to be operated only a few hours each day.

At Easton, Pa., a test plant was installed in 1919 for demonstrating the practicability of the improved devices of Mr. Landreth, in which use is made of both electricity and lime, followed by sedimentation. The test plant was studied by several engineers and chemists of Philadelphia with results as stated in a paper presented to the Franklin Institute in 1919. The Easton plant was also investigated by the Pennsylvania State Department of Health with results as summarized in Engineering News-Record of Sept. 18, 1919, p. 569.

As the "direct oxidation process" now stands, it may be fairly stated that it has received widespread attention and that the merits of the process have come into sharp controversy. This means that adequate data for giving the process a true rating are seemingly lacking, at least to the extent of being persuasive to the minds of many. Briefly the opponents claim this process to be no more efficient than if lime alone is used; that the process is unreasonably expensive to operate, especially where the sewage contains a very high amount of hardness requiring a large dose of lime; that the effluent, while very well clarified due to the coagulating effect of magnesium hydrate, is not purified of its organic matter to a degree sufficient to serve the local requirements at many places; and that the destruction of bacteria by the process is not due to the action of electricity but on the contrary to the excess of caustic lime in the effluent, which ranges from 30 to 80 parts per million.

On the other hand, the proponents of the "direct oxidation process" claim that it is cheaper to install than plants of the biological type; that it permits an attractive looking and inoffensive plant to be located within built-up portions of the city; and that it allows the sludge to be handled in an inoffensive condition and dried so as to produce a product that is marketable.

Situation at Lima, Ohio

It is not the purpose of this paper to go into great technical detail but rather to outline some of the main comparative features of the so-called "direct oxidation process" and of so-called "biological processes" as they have come into competition at Lima, Ohio. Controversial aspects of the local sewage problem as it now stands at Lima have produced a deadlock for the present year, leading to a series of claims and counter claims which are of some interest and perhaps of value as a warning guide.

Lima is a city of about 45,000 population with several large manufacturing plants and a growing population outside the present city limits. It is located on the Ottawa River, having a drainage area of about 100 square miles. The flow of this stream, which passes through the heart of the city, becomes almost nominal during summer and is lessened by storage reservoirs above the city into which water is pumped from the river during periods when there is a substantial flow. The result is that the stream bed is practically an open sewer from which offensive odors emanate for a distance of several hundred yards on either side.

Due to the complaints of riprarian owners below, the State Department of Health under the terms of the Bense Act ordered the city to purify its sewage. Fuller & McClintock made a report in 1916 on relief sewers, intercepting sewers and treatment works, recommending the adoption of the activated-sludge method. But little was done during the war period and beginning in 1919 construction work related largely to relief sewers to improve conditions in the built-up part of the city where the original combined sewers proved inadequate.

In 1921, Fuller & McClintock were engaged to design intercepting sewers and treatment works. After considering the problem in detail they recommended the adoption of fine screens followed by trickling filters and final settling tanks equipped with Dorr thickeners. This decision, differing from the preliminary report of 1916, was made partly because of inability, with the activated-sludge process, to treat the sludge in a way to yield any proceeds from its sale, but chiefly because under the Ohio law it is highly desirable, if not essential, to keep the operating expenses of sewage treatment plants at a minimum.

Under the terms of the amended Bense Act the interested charges on bond issues required for the construction of sewage treatment works when ordered by the State Department of Health to correct a nuisance, are not required to be paid from the general fund raised by taxation, to which there is a maximum limit of 15 mills per dollar of assessed valuation. Operating expenses for treatment works, on the other hand, must be paid out of funds raised by taxation and must be kept within the 10-mill rate unless there is a special election to authorize, by vote of the people, a special tax above this limit; but in any event a limit of 15 mills cannot be exceeded.

Plans and specifications for the fine screens and trickling filters were completed and approved by the State Department of Health, subject to the provision that preliminary sedimentation would be required if found necessary. A letting was authorized, with bids to be received on April 1, 1922. About a week prior to this date, the Municipal Disposal Co. of Philadelphia persuaded the City Commission at Lima to postpone the date of the letting and to take steps towards receiving alternate bids for a plant of the Landreth "direct oxidation" type. Plans and specifications for the latter were prepared and submitted to the State Health Department for approval. Specific data on the cost, method and adequacy of performance of the "direct oxidation process" have been requested of the city officials by the State Department, and Col. George A. Johnson has been retained by the city to obtain information in respect thereto.

Several months have elapsed during which the merits and demerits of the trickling filter method (Contract A) and of the "direct oxidation process" (Contract A-II) have been debated pro and con by the various parties in interest. Briefly, the situation may be summed up by the following paragraphs;

1. The installation cost of pumping station and treatment works by the trickling filter method, with its established record of adequacy and successful performance for a quarter of a century, was estimated in December, 1921, at $691,000 as compared with a sum said to be about $400,000 for the proprietary arrangement with a number of novel features not yet worked out on practical scale on a sizable plant.

2. The annual operating cost of the trickling filter method, including all pumping, fine-screen operation and sludge disposal from final settling tank, is estimated to range from $13,000 to $15,000 in comparison with which is an estimated sum of $40,000 for the "direct oxidation" process. In this latter process it will be necessary to use, according to tests at Lima, about 2,800 lb. of lime per million gallons and about 150 kw.-hr. per million gallons for electrolyzers, in addition to the costs of pumping and screen operation, attendants for pumps, fine screens, electrolyzers, Dorr tanks, and sludge drying plant (three tons dry basis per million gallons) of the vacuum filter type. These estimates in each case are for fine screens operating at the rate of 4 m.g.d. for twelve months per year and secondary treatment for the seven warmer months. As the quantity of sewage increases later the financial disadvantage of the "direct oxidation process will increase.

3. As to quality of effluent, the trickling filter plant will produce an adequately clarified and nonputrescrible effluent, suitable for discharge into the Ottawa River. As regards clarification, the "direct oxidation" process, when an adequate dose of lime is applied, will produce the same result. But as to the removal of dissolved organic matter the evidence indicates that the "direct oxidation" process is no more efficient than "excess lime treatment" alone and that dissolved organic matter is not removed with substantial completeness but is simply left undisturbed in a sterile effluent so long as sufficient caustic alkalinity remains.

4. The "excess lime treatment" for sewage is not a novelty but was employed at London more than

30 years ago and was abandoned on account of the secondary putrefying reactions which took place with the organic matter on the bottom and sides of the River Thames.

One Year's Operation of a Direct Oxidation Plant

Conclusions Derived as a Result of Actual Experience Gained in Allentown

By H. F. BASCOM
City Engineer, Allentown, Pa.

Allentown has a population of about 90,000. Plans for direct-oxidation sewage-works for a part of the city, prepared by me, were approved by the Pennsylvania Department of Health, Oct. 1, 1919. The ultimate sewage flow tributary to the works is estimated at 1.91 m.g.d. of sewage uncontaminated with trade wastes with 2.8 m.g.d. maximum. The plant includes fine screens with ¼-in. circular perforations; grit chambers; a Venturi meter; lime storage and dosing apparatus; three sets of 1-m.g.d. electrolyzers, each consisting of 48 plates spaced 3/8 in. apart, the plates being cleaned by revolving paddles; sedimentation basins, with a detention period of 1½ to 2 hours at full 3-m.g.d. capacity; and sludge drying beds.

During the past year the plant treated 73,000,000 gal. of sewage without the slightest evidence of nuisance or complaint and produced an effluent which was consistently and uniformly stable and of low bacterial count.

Table I—Results of Sewage Treatment at Allentown, Pa.

	Raw Sewage P.P.M.	P.P.M. (1 Hr. Settling) Effluent	Per Cent Change
Suspended solids			
Total	150	69	—54
Volatile	110	46	—58
Oxygen consumed	17	8.1	—53
Free ammonia	21	13	—33
Nitrogen			
Dissolved	10.4	7.7	—26
Total	24.0	14.6	—39.1
Chlorine	117.0	123.0	+ 5
Alkalinity (as $CaCO_3$)	287.00	*50	....
Bacteria			
Total 37°C	2,036,000	12,000	—99.6
B. Coli	87,000	18	—99.98

*Causticity as CaO

The sewage is a normal sanitary sewage and its composition as well as the average composition of the effluent is shown in Table I.

Allentown is unfortunate in that its water supply is well above the average in hardness and therefore the sewage requires much more lime than many other communities. Accurate records of cost show that when the plant operates at full capacity, or 3-m.g.d., the cost would be as given in Table II.

Table II—Operating Costs, Allentown Sewage-Works

Unit cost per 1,000,000 gal., based on operation at full 3-m.g.d. capacity.

Power 213 kw.-hr. @ 2.8c	$5.96
Lime 0.6 ton @ $9.10 per ton (86% CaO)	5.46
Operators: 1 @ $135; 2 @ $125; 1 @ $100 per mo.: 2 laborers @ 40 c. per hour	7.61
Heat	.08
Light	.17
Miscellaneous supplies and repairs	1.02
	$20.30

Sludge

The sludge as removed from the sedimentation basin contains 94 per cent moisture and amounts to 21 cu. yd. per million gallons. After 4 to 6 days drying on the sludge beds in normal weather the volume shrinks to 11 cu. yd. and the moisture content drops to 71 per cent. Therefore when dry the sludge will amount to about 3 cu. yd. per mllion gallons.

The wet sludge from the sedimentation basin was absolutely free of colon bacilli, contained 44,000 per c.c. of total bacteria and when diluted with river water and distilled water had a stability of over 99 per cent with methylene blue in dilutions ranging from 1 to 25 up to 1 to 1,000.

During the year the sludge has in the main been satisfactorily used for filling around the plant, although in some instances truckers have carted it away and used it on their farms, and they report that it is a very good growth stimulant, soil corrector, and improves the mechanical property of the soil.

Several improvements have been made in the lime dosage during the year, a new slacking chamber installed and the lime added further upstream from the electrolyzers, giving better slacking and mixing, also effecting a saving of approximately 25 per cent in the quantity of lime used.

Lately a new type electrolyzer was installed and tested out, showing a reduction of 50 per cent in the hydraulic head required as well as an electrical efficiency considerably greater than the older type. This unit has the same effective electrode area as the older ones but contains only a single row of ten banks of electrodes and the agitators reciprocate instead of rotate, being driven from the top instead of the side.

Comment has been frequently made that the direct oxidation process is no more efficient than lime alone. In this connection a great number of tests have been made at Allentown both by the city chemist and by other investigators and the results are conclusively in favor of the direct oxidation process, which gives an effluent that shows a greater reduction in oxygen demand, oxygen consumed, organic nitrogen and bacteria.

These tests also showed that the effluent produced by lime treatment, even though practically sterile when discharged, will putrify if mixed with river water, while that from the direct oxidation process will stand up indefinitely.

Conclusion

A very significant feature about the operation of the direct oxidation process is that it is mechanical in nature and depends for its success, not upon the delicate adjustment of conditions in an endeavor so far as possible to favor the caprices of bacteria life, but solely upon simple mechanical contrivances whereby lime is fed into the sewage in sufficient quantities to render that sewage always slightly but definitely caustic, and thereafter to maintain an uninterrupted charge of electric current in the electrolyzers. Outside of these features the process is automatic.

Except in the screen room, where the raw sewage passes over the screens, there is no odor of sewage, stability being obtained in the electrolyzing units without production of odor. No odors are present outside the building even from the sludge beds. Fly and mosquito nuisances such as is always prevalent at all other kinds of sewage-works are unknown at the Allentown plant.

The plant operates irrespective of weather or temperature conditions. The variation in flow of sewage through the electrolyzers up to the capacity of the unit has no effect upon the current required; in other words, any quantity of sewage up to the capacity of the unit requires the same amount of current as the rated flow.

Discussion of Above Papers

By G. A. Johnson

In no other branch of public sanitation has there been less real progress made than in sewage treatment.

Bacterial purification of sewage is only incidental to any "purification" which it undergoes in the great bulk of the accepted sewage treatment processes of today. Keep the steam "sweet," attractive to the eye and inoffensive to the olfactory sense, and leave to the water purification plan the job of making the water supply safe for human consumption. That is the concept of the sanitary mind today.

I question the soundness of such promises when I realize that the cost of ideal sewage treatment is one of the real reasons why we do not strive for higher degrees of sewage purification. Some years ago Hazen said that the public derived more benefit from one dollar spent for water purification than from ten dollars spent for sewage treatment. In a broad sense he was right. Money spent for water purification returns a direct measure of protection of the public health against water-borne disease. Money spent for sewage purification results in an incomplete and indefinite benefit. It minimizes the danger from pathogenic germs by reducing their number. It cannot give absolute protection as can water purification, because even if every city, town and village in the country should treat its sewage to a point of innocuousness before discharging it into public waterways, it must still be remembered that those waterways drain areas populated or traveled by human beings whose evcreta are not always collected in sewer systems, but sometimes are deposited at points on the watershed from which they find their direct or indirect way into the nearest stream or lake, thus to pollute it, maybe dangerously, and in any event incontrovertibly to render all surface water potentially unsafe for human consumption unless properly purified before being delivered through the mains to the consuming public.

Today after thirty-five years' practice beginning at the Lawrence Experiment Station of the State Board of Health of Massachusetts, we have "advanced" to a point where we judge the efficiency and worthiness of a process of sewage treatment by its ability to turn out a fair clear effluent which by itself will remain stable for a few days. Everything is incidental. High bacterial purification is considered desirable but no particular point is made of it.

Why are we willing to allow sewage treatment plants to pour uncountable billions of bacteria into our public waters every hour of the day, when such waters must be used later for public supply? Why are we willing to accept sewage treatment works which we know with positiveness will fail several times during an average year, particularly during cold weather? Why do we complacently impose upon the water purification plant the full responsibility of protecting the public health against water-borne disease?

If it were the rule for every community to purify its sewage thoroughly and not incompletely and uncertainly, as is almost always the case, all would be well; but where only the elimination of gross nuisance in streams is the prime consideration, as we know it mostly is, it is not easy to convince the people of one municipality that they owe a debt of common decency to their neighbors which they should pay—even if their neighbors are not similarly minded—and so become pioneers in a movement which would do so much towards actually cleaning up our public waterways and lessening the growing burden on water purification systems.

Direct Oxidation

Everyone knows, or should know, that of all the processes of sewage treatment operation today there is only one which for its success does not depend upon the capricious activities of bacterial life. The "direct oxidation" process is not a biological system but a combination of mechanical devices depending not at all upon bacterial actions which fail signally at times and at best are unreliable—but merely upon the faithful operation of certain relatively simple mechanisms. An effluent results which is practically free from suspended matter, which is stable and which contains but very few bacteria. Furthermore, the effluent is uniformly stable, as is the sludge—which is true of the sludge from no other process. Moreover, there is no local nuisance created around such plants, something which has never before been true of any other type of sewage-works. All of these facts were well demonstrated during my recent test of the direct oxidation plant at Allentown, Pa.

The cost of sewage treatment by the direct oxidation process is fairly comparable with that of other well-known methods which are far less easily managed, less reliable and all of which are certain nuisance breeders in some particular and in varying degree. At Trenton, N. J., for example, where I am preparing plans for a plant of this type, the total cost of treatment, including all charges, is estimated at about $20 per million gallons.

It is true that this process is patented, as is some of the apparatus used in it; that it is exploited commercially. I cannot see, however, wherein these facts need be given adverse consideration. We can use other processes, even the patented Imhoff tank, and obtain inferior and always uncertain results at less cost; or we can use this process, which, in the minds of some oblique-minded people, bears the stigma of a commercial exploitation, and obtain what we want and need, continuously and reliably, winter and summer, and at reasonable cost.

Must we shut our eyes to the advantages of definitely cleaning up our public waterways, continuously and permanently, and not as an intermittent and incomplete proposition, merely because a process which gives great promise of being able to serve this purpose best is a patented one susceptible of commercial exploitation? Some municipalities and some engineers adopt a discriminatory attitude toward patented devices, in some cases with good and sufficient reason, no doubt, but in the case in point if we favor the direct oxidation process over all others solely because of its merits and potentialities, and where cost factors are not clearly prohibitive, are our efforts to be discredited on the questionable grounds of unreasonable bias and unwarranted idealism?

The following figures give the amount of concrete road laid in Canada during the present year, the amounts being square yards in each case: Quebec, 138,300; Ontario, 1,300,000; Manitoba, 4,500; Saskatchewan, 10,000; Alberta, 8,000; British Columbia, 58,000; total 1,518,800.

$35,000 Electric Plant for Hanna, Alta.

The Municipality of Hanna, Alta., have recently placed a contract with the Canadian General Electric Company, Ltd., for the supply of one 125 kv.a., 514 r.p.m., 2,300 volt, three phase, 60 cycle generator with direct connected exciter; the same company will supply a Goldie McCulloch high speed vertical forced lubrication engine and two Canadian Allis Chalmers boilers 72 by 18, 150 h.p. return tubular, together with two steel smoke stacks 36 inches diameter, and 60 feet high. Further equipment by the same company include a panel for the generator, a constant street lighting transformer, with control, and a number of lightning arresters; also feed water boilers and deep well steam pumping equipment. This machinery will be installed by the Canadian General Electric Co. Ltd., who are co-operating with Haddin and Miles Ltd., consulting engineers, Calgary, Alta. In connection with the same piece of work contract for the pole line construction has been let to E. Kelly; poles to Electrical Engineers Ltd.; building of power house to J. E. McFarlen, and drilling wells to P. O. Dyrnes. The total contract for plant and transmission will be approximately $35,000.

First Storey Columns of Twenty-seven Storey Building Removed

When it was decided to build an addition to the American Telephone and Telegraph Building at Broadway and Fulton Street, New York, some extremely heavy column loads had to be transferred to new columns to carry out the original scheme of architecture in the old building. The old building was twenty-seven storeys high, and three columns and the wall between the old buildings and the new one had to be removed, so that the column spacing could be carried through, in the first storey, the same in the addition as in the old building.

After an extensive study of the different methods of transferring the load, the plan finally adopted was to carry the old column loads of some 1,300 tons on cantilever trusses. These trusses were fifteen feet in height and were placed between the third and fourth floors. It was found that the maximum stresses occurred in the chords, the cantilever end post and the adjacent web member when the cantilever end was fully loaded and the back arm fixed. The maximum stress in the rest of the web members occurred when the cantilever end was fully loaded and the back arm free.

On an operation of this size, it was necessary to avoid any sudden relief of loads so it was decided to let the anchor arm of the truss hang free, connect the cantilever arm to the column, and then erect the building on the truss. In this manner, as the load on the truss increased, the load on the column would be delivered, provided the fulcrum column was not allowed to get shorter due to compression. This was taken care of by erecting this fulcrum column on four 500 ton hydraulic jacks so that the top of the truss could be maintained at the same level throughout the operation.

The splice plates of the old columns were cut at the first floor level so that the load on the column could be relieved without lifting the basement load. Extensometer readings were taken on the columns and truss members. As soon as it was found by computed loads and extensometer readings that the load on the bottom of the old columns had been relieved, the column under the anchor ends of the truss was rivetted to the truss and the work proceeded.

The jacks rested on the lower tier of grillages and were attached to the column by wing plates. The permanent base plate under the column was bevelled and wedges were inserted which were operated by screw jacks. It became necessary to remove the jacks before the load was all transferred on account of pouring a mass concrete engine bed, part of the space for which was occupied by the jacks. They were removed at the last possible minute short of delaying the job.

The old columns were cut when the new building was practically enclosed and in one of the trusses no difference in level of the cantilever end of the truss was observed and in two of the trusses a drop of slightly less than 1/16 of an inch was noticed. The work was most successfully accomplished.

Obituary

Mr. Charles P. Loveland, C. E., of Montreal, died recently at his home in that city, following a long illness. Deceased was born in Bangor, Maine, 51 years ago and had been a resident in Montreal since 1907, in which year he came to that city from Boston to carry out some work. Later he became associated with Leahy Construction Company, becoming president of this concern, which constructed many of Montreal's sewers and streets. He later was president of the Great Lakes and Atlantic Power Company and of recent years was connected with the J. W. Harris Manufacturing Company, Ltd. Mr. Loveland was an associate member of the Engineering Institute of Canada.

Mr. Henry Percy Borden, C. E., of Ottawa, died recently at his residence there. Deceased was a resident of Ottawa for the past six years and but a few months ago entered private practice as a consulting engineer. He was born in 1872 at Port la Tour, N. S., and received his professional training at McGill University, graduating in 1902 with the degree B.Sc. He began his engineering career with the Bridge Department of the C. P. R. Co. at Montreal, where he remained for two years, following which he was appointed assistant chief engineer of the Structural Department of the Montreal Locomotive Works. Two years later he returned to the C. P. R. as architectural engineer and in 1908 was appointed to the staff of the Quebec Bridge Commission, as assistant engineer and secretary. In 1915 he was promoted to the position of assistant to the chief engineer of the commission and in the following year he was appointed to the Board of Engineers of the Quebec Bridge, which position he held until the completion of the structure in 1918. During 1919, 1920 and 1921 he was employed by the Dominion government in a consulting capacity, later entering into business for himself. He was a member of the Engineering Institute of Canada and of the American Society of Civil Engineers.

Trade Incorporations

Superior Concrete Products, Ltd., with head office at Toronto, capital $50,000 to manufacture concrete products and carry on the business of building contractors.

Niagara Double Wall Construction Co. Ltd., with head office at Hamilton, capital $40,000. The temporary address of this company is c/o H. E. Dowling, solicitor, room 505, 66 King St. E.

The Canadian dollar is at a premium in every country in the world.

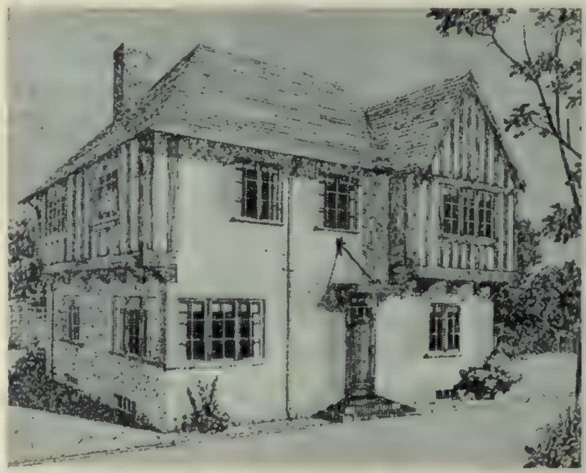
The Contract Record's

Weekly House Suggestion No. 42

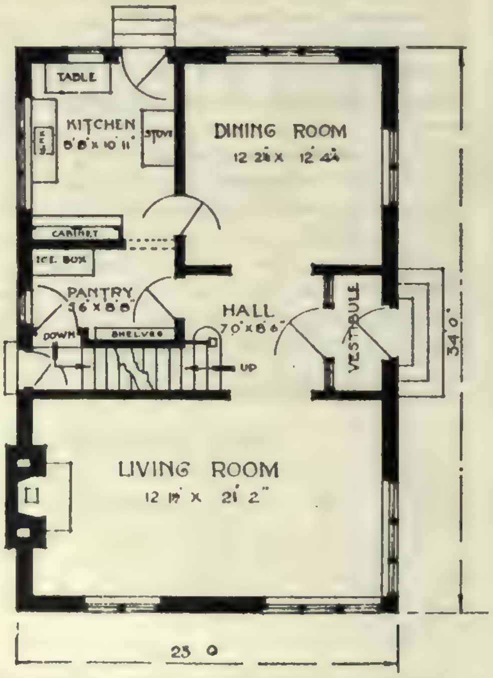
Our house suggestion this week is one that will appeal to the reader who appreciates refinement and simpleness of design. It is a type of house that is readily adaptable to either a corner or inside lot and can face the street as in the illustration or be built with the long side of the living room to the front, as shown in the plan. The construction is stucco on brick and the handsome half timber effect, especially effective on the side wall over the living room and in the gable at the front, adds materially to the charm of the exterior appearance. In keeping with the general appearance is the simple entrance at the front, with suspended canopy and brick steps. The windows are all of the French casement type and the roof is of stained wood shingles.

The interior of the house is especially well laid out and includes the popular features of a large living room, convenient kitchen and pantry location, many roomy linen and wardrobe closets on the bedroom floor, etc. The three large window openings on the living room at once suggest an abundance of natural light. There is a handsome brick fireplace situated in the centre of the rear wall of this room, as seen on plan. The hall is quite wide in this design and has direct entrance on living room, dining room and pantry. There is a swinging doorway between the dining room and the kitchen and the latter room has entrance from the outside at the right.

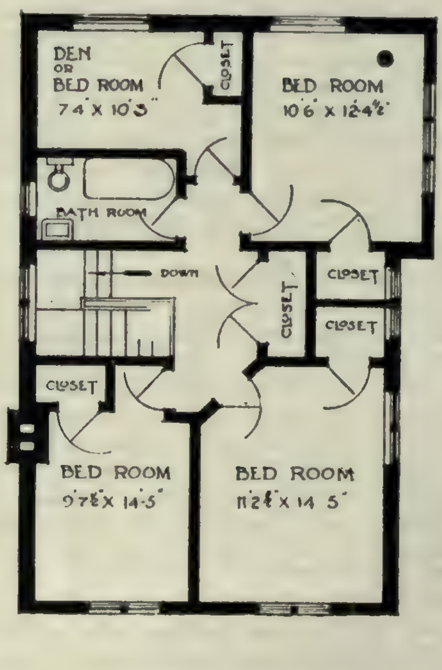
Convenience in layout has also been accomplished in the bedroom floor plan, the rooms being all located immediately off the hall. As there are three bedrooms besides the small room adjoining the bathroom, this latter might very well be utilized as a den or sewing room.



This is an exceptionally well designed home and is within the means of the majority of prospective builders, it being estimated that it can be built for $6,500.



FIRST FLOOR PLAN



SECOND FLOOR PLAN

Mainly Constructional

East and West—From Coast to Coast

The calling for tenders for the construction of a new bridge between the Island of Montreal and Ile Perrot was made the occasion of a festive gathering in the Oak Room of the Windsor Hotel, at Montreal a few days ago, when members of the Ile Perrot Bridge Commission, headed by Mr. T. B. Macaulay, their president, entertained at lunch a large number of mayors of municipalities, members of the provincial Legislature and ministers of the Quebec Government, including Premier Taschereau, to celebrate the successful conclusion of the commission's efforts to obtain the bridge.

A recent report states the research department of the University of Alberta has made evcellent progress in developing a good road surfacing material from natural tar sands from the Fort McMurray district. A process has been developed whereby the asphalt can be extracted from the sand. It is planned to carry investigations on during the winter, the university having secured twenty-two tons of sand which will be reduced. With the four or five tons of asphalt obtained, stretches of rural roads will be surfaced. If this surfacing stands the test, it is expected the development of the deposits will assume large proportions. Two tons of the sand have been brought to Edmonton by the Dominion Government, and all those who desire an opportunity to experiment with them can obtain samples from the lands office here. The McMurray field comprises 750 square miles of tar sand deposits ranging to 180 feet in depth along the Athabasca river and its tributaries, according to a government engineer who recently concluded a special investigation.

Administrator W. W. Pearse has had miniature plans of all Toronto Public and High Schools prepared and put in book form, with provision for plans of additions to schools as they are made. Trustees will now be able at a glance to take in the situation without having to go over huge rolls of drawings.

Ratepayers of Victoria and the adjoining municipalities included in the Greater Victoria plan will be asked to vote on the proposed creation of a water board to take complete control of all municipal waterworks projects and who would also be given the right to expropriate all private and government waterworks projects.

A house building committee consisting of Mayor Le Heup, and Messrs. H. L. Slaght and H. C. Dunbar was appointed recently at Haileybury, Ont., and also a town-planning committee of the Mayor and six members.

The ratepayers at London, Ont., at the next municipal elections on December 4, will vote on a proposed new city hall to cost $250,000 and a new nurses' home to cost $300,000.

The Sydenham Brick and Tile Company, Limited, Wallaceburg, Ont., are considering removing their plant to a new location, suitably provided with railway sidings, and installing driers and conveying equipment.

The plans for the new city hall at Kitchener have been approved by the city council and the architects have been instructed to call tenders. It is planned to complete the work of excavation, installation of footings and foundations before the end of this year and it is expected the entire structure will be finished by the end of next year.

Mr. A. W. Campbell, Dominion Commissioner of Highways, addressed a national conference on education for highway engineering and highway transport, held in Washington recently, on the subject "Trend of Highway Engineering and Highway Transport Education," telling what is being done along these lines in Canada.

The $100,000 building which the St. Thomas Packing Company is erecting at the corner of Division St. and Hellems Ave., Welland, Ont., will be completed early in the spring, according to a recent report. This will be a two-storey structure, of stucco with cement trim, and will contain, in addition to space occupied by the company, four modern stores on the ground floor and six apartments above. The tenants of the apartments will have refrigerator facilities which require no ice and each apartment will be equipped with electric range and other electrical conveniences, built-in kitchen cabinets and buffets, etc. The company will occupy ten rooms in the building, ranging in temperature, for the handling of everything required of the modern cold storage plant. This building will be one of the most up-to-date of its kind on the continent.

The Johns & Wood Novelty Stone Works are now operating their new plant at 59-65 Hillyard Street, Hamilton. Their products include dash for stucco finish on buildings, in about ten different colors; marble chips for terrazzo flooring in a variety of colors; a new roofing gravel for tar and gravel roofs, and talc and ground slate for roofing material. All material used in the company's products comes from their own deposits in Ontario. Later on they propose to take stone from their mines for building and monumental purposes. The plant has a daily capacity of five carloads

The Red Wing Quarry Company, Limited, have issued their prospectus, outlining their plans for operating in North Bay, Ont. They propose to construct a large stone crushing plant for the preparation of building material, such as stone aggregates and dust in various sizes and colors, for use in stucco, magnesite, terrazzo and tile floors, and also art sands, grits, powders, etc. They have acquired several deposits of different varieties of rock, which supply the plant at North Bay, where they have a building site of eight acres. The company have an authorized capital of $500,000. Directors and officers are: Arthur T. Stone, president; J. H. Bremer, secretary-treasurer and general manager; Homer Stockdale, all of North Bay.

A deputation from the U. F. O. body, headed by Mr. W. A. Amos, recently appealed to the Special Committee which is endeavoring to consolidate the Motor Vehicles Act in Ontario, protesting against any proposals to eliminate farm tractors and heavy threshing outfits from the use of the highways. It has been found that much damage has been done roads throughout the province by the passing of this type of equipment over them, but the deputation pointed out that to prohibit the travelling of threshing machinery over the highways would impose great hardship on the farmer. A proposal was made to have the government take the matter up with the tractor manufacturers, in an endeavor to devise a covering for the destructive cleats in the wheels of heavy equipment.

Personal

Mr. N. H. Necker, S.C.B.E., general superintendent of the Provincial Highways Department of Quebec, addressed the Kiwanis Club at Quebec city recently on the subject of "Road Building."

Messrs. R. O. Wynne-Roberts and H. L. Seymour, of the Toronto engineering firm of Frank Barber & Associates, Ltd., left for Haileybury recently, where they will devote their services to the re-planning of this district and the reconstruction of the water system.

CONSTRUCTIONAL ACTIVITY

Period of Oct. 25 to Oct. 31, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Hamilton, Ont.

City Council will construct pavement on King W., from Dundurn St., to McKittrick Bridge. E. R. Gray, Engr.

City Council plan construction of brick and concrete roadway at cost of $10,000 on Mountwood Ave.

City Council plan construction of cement walk and curbat cost of $17,000 on both sides King St., from Bond St., to Cline Ave..

City Council plan construction of asphalt pavement at cost of $6,000 on Caroline St.

Hull, Que.

City Council will construct sewers at cost of $100,500 and waterworks extensions costing $59,000, work by day labor. Theo. Lanctot, Engr.

Ottawa, Ont.

City Council will construct storm sewer at cost of $50,000 on Harmer St., work by day labor. A, F. Macallum, Commr. of Works.

St. Marys, Ont.

Town Council plan watermain extension to cost $7,500 on Elizabeth Ave.

Sandwich South Twp., Ont.

Twp. Council contemplate tile drainage work to cost $75,000. Jno. McAuliffe, clerk, Oldcastle, Ont.

Toronto, Ont.

Tenders will be received until Nov. 14th for the following work for City-(A) Construction and delivery of high pressure service 20 in. cast iron pipes and high pressure fire service 12 in. and 20 in. stop valve and 20 in. check velves. (B) Construction and delivery of 5-24 in. stop valves and 1-24 in. check valve.

Tenders will be received until Nov. 7th for laying and jointing 6 inch water pipes on three streets for City. Specifications at Room 320, City Hall.

CONTRACTS AWARDED

Birchcliffe, Ont.

Contract for grading costing $7.200 for Scarboro Twp. Council is awarded to Law Construction Co. Ltd., 107 Hillsdale Ave. E., Toronto. C. E. Fraser, Engr., Bank of Commerce Bldg., Stop 19 Kingston Rd.

Cloverdale, B. C.

A. B. Palmer & Co. Ltd., Vancouver Block, Vancouver, have general contract for roadwork costing $60,000 on Yale Rd. for Prov. Gov't.

Crooked River, Sask.

Hett & Sibbold, Prince Albert, have general contract for construction of highway costing $7,778 for Prov. Gov't.

Montreal, Que.

City Council awarded contract for paving to Quinlan, Robertson & Janin Ltd., 50 Notre Dame W.

Duranceau & Duranceau, 152 Hamilton St., have general contract for sidewalks costing $20,000 for City.

Toronto, Ont.

Following contracts have been transferred from Commr. of works: Paving on Terauley St., Bloor to Davenport, Godson Contracting Co., Manning Chambers; sewers, Bartlett Ave., J. H. McKnight Construction Co., 88 St. David St.

Trenton, Ont.

Weddell & Saunders, Trenton, have general contract for reinf. concrete collecting reservoir, pumphouse and watermains for Trenton Water Cmsn. James, Proctor & Redfern Ltd., Engrs., Excelsior Life Bldg., Toronto.

York Twp., Ont.

Paving contracts for York Twp., Council are awarded to Asphaltic Concrete Co., Excelsior Life Bldg., Toronto, and Kilmer & Barber, 24 Adelaide W., Toronto. Frank Barber & Associates Ltd., Engrs., 40 Jarvis St., Toronto.

Railroads, Bridges and Wharves

CONTRACTS AWARDED

Tingwick, Que.

Steel contract for 2 bridges for Council is awarded to McKinnon Steel Co. Ltd., Sherbrooke, Que.

Public Buildings, Churches and Schools

Hamilton, Ont.

City Council plan construction of jail, S. H. Kent, City Clerk.

Erection of fire station is contemplated by City Council.

Invermere, B. C.

Plans are being prepared for church to cost $8,000 for Bd. of Trustees, Church of England. Rev. F. B. Atkinson.

Kingston, Ont.

Stevens & Lee, architects, 62 Charles St. E., Toronto, have plans and will receive tenders until Nov. 10th. for erection of laundry bldg. for Kingston General Hospital.

Kitchener, Ont.

W. H. E. Schmalz, architect, 288 Frederick St., has plans and will receive tenders until Nov. 8th. for erection of City Hall to cost $250,000 for City. Bid Bond required.

Montreal, Que.

Executive Cmsn. will receive tenders until Nov. 15th. for distribution control bldg. Part "A" for City. Plans with Water Bd., 19 Atwater Ave.

New Toronto, Ont.

Erection of town hall is contemplated by council. W. H. C. Millard, Clerk.

Niagara Falls, Ont.

C. M. Borter, architect, 102 Main St.. is preparing plans for addition to school to cost $36,000 for School Bd.

Ottawa, Ont.

Erection of synagogue is contemplated by Congregation of Murray St. Synagogue. Members Bldg. Com., M. Lachoviteh, 262 York St., M. Adelstein. 279 Elgin St., and N. Wolfe. 118 O'Connor St.

Tranquille, B. C.

Plans are being prepared for school for Prov. Gov't., Dep't. Pub. Works. H. Whittaker, architect, Parliament Bldgs., Victoria.

CONTRACTS AWARDED

Barton Twp., Ont.

Plumbing and heating contracts for school for S. S. No. 3, Barton Twp.. are awarded to A. Clark & A. Rogers, 7 Main St. W., Hamilton. J. A. Armes, architct, 67 Charles St., Hamilton.

Bertie Twp., Ont.

Horace Gray, 5th. Ave. S.. Welland. has general contract for alterations and addition to school costing $28,104 for S.S. No. 4. Plumbing and heating contracts are placed with E. Cardwell, 32 Division St., Welland. N. A. Kearns, architect, Temple Bldg., Welland.

Claymont, Alta.

General contract for erection of school for Claymont S.D. No. 3455 is awarded to Wm. Glenn. Woodbent P. O., Alta.

Gravenhurst, Ont.

General contract for erection of Carnegie Library costing $7,000 for Town is awarded to A. C. Ferguson, Gravenhurst. C. S. Cobb, architect, 71 Bay St., Toronto.

Mimico, Ont.

Contract for stone for church costing $30,000 for Methodist Church Congregation is awarded to Peerless Artificial Stone Co. Ltd., Coxwell Ave., Toronto. Horwood & White, architects Ryrie Bldg., Toronto.

Montreal, Que.

Contract for sash and doors for school and residence costing $200,000 for Catholic School Cmsn.. West District, is awarded to Allard & Desnoyers Ltd., 12 Erie St. Chas David, architect, 3 Burnside Place.

Additional contracts for school costing $200,000 for Catholic School Cmsn., North District, are :Roofing plumbing and heating, Turcot Ltd., 1681 Clarke St.; electrical, J. A. St. Amour, 2173 St. Denis St.; art stone, Castona Products Ltd., 4 Harbor St.; orn. iron Montreal Architectural Iron Works Ltd., 145 Prince St. E. Cormier, architect, 511 St. Catherine W.

Additional contracts for school and residence costing $170,000 for Catholic School Cmsn., East District, are: Roofing, M. Chouinard, 751 Adam St.; elec-

ESTABLISHED 1886
Contract Record
and Engineering Review

A National Journal for the Construction Interests of Canada,
reaching Architects, Engineers, Contractors
Municipal Officials, etc.

Published Each Wednesday by
Hugh C. MacLean Publications
LIMITED
THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News,
Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES
Canada, Great Britain and British Possessions $3.00. U. S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 **Toronto, November 8, 1922** **No. 45**

Should Motor Truck Loads Be Limited?

Motor truck load limitation has been advanced and advocated by many as the sure remedy for the destruction of rural highways. Even government highway engineers, in their concern for the roads that have been constructed or are maintained under their jurisdiction, have shown a disposition to place almost the entire blame for road destruction on overloading of motor vehicles. Thus, Hon. Mr. Biggs, Minister of Highways for Ontario, is reported to have stated during a recent tour of inspection: "Some of these days truck owners will find a new kind of traffic cop working. His tool will not be a stop watch, but a load meter. . . . . .If a truck is carrying more than its licensed load, the cop will order the driver to put off part of it on the roadside. . . . . .That is going to end overloading and the ruination of roads." Further, he is said to have stated: "It is probable that under the new laws, the province will issue no licenses for these heavy trucks [5 tons or over-Ed.] for cross-country service and that the owners of such, who must scrap their trucks will be compensated from the provincial treasury."

While we do not doubt that Mr. Biggs and others are well intentioned in their motives and are prompted by a sincere desire to minimize the deterioration of the roads, at the same time we feel that they have not viewed the relationship of overloading and road destruction in quite the right light. True, we must give very serious and studied consideration to the matter of road deterioration, especially in view of the heavy expenditures that are being made at the present time for the construction of the expensive types of highways. Yet, there are other factors involved in road destruction than the mere weight of the load passing over the road; in fact, of more importance than the extent of the load is its distribution. There are on the market trucks with bodies and chassis so ill proportioned that the weight instead of being properly balanced is practically all thrown on the rear wheels, which, in consequence, are so inadequately tired and of such insufficient width, that serious damage to the roads is bound to result. Far more effective results can be obtained by ruling out the improper distribution of loads than by curtailing truck capacity.

Speed, of course, is an important factor and should be limited to correspond with the load. With a properly distributed load, proper tire width and proper speed, there need be no fear regarding the extent of damage to the roads. Just as soon, however, as the weight is improperly balanced and the speed is unduly increased, then will destruction to the roads commence. The importance of a properly distributed load operated at a proper speed is well illustrated in the case of a road construction operation just east of Toronto, where for the past four months, fifteen seven-ton trucks have made ten to fourteen trips per day each at a speed of eight miles per hour, over a recently constructed highway, with no noticeable ill effects whatever. It was the proper distribution of the load carried at a properly limited speed that guaranteed this record. The moral surely is that it is not heavy loads that should be legislated against, so much as their improper distribution and excessive speed.

Elimination of Revised Bids

How to eliminate one of the most pernicious practices in the construction industry—the revision of proposals after bids have been received by the owners —is a difficult problem.

One case has just arisen where a contractor submitted a bid on important work, which was considerably lower than any other. The bids were opened before the bidders, but the owners, wishing to reduce the cost, asked for new bids after specifying certain minor changes.

This is an example of what is occurring more or less frequently. Advantages have been taken of the individualistic nature of contracting and contractors in what was almost a universal practice of making contractors enter into price-cutting competition by first receiving bids, and then making minor changes in the plans and specifications, with the expectation that each contractor would take a slice off his profit.

This situation has been overcome in different ways. In one locality, the contractors filed a copy of their proposals with the secretary of their local association with the understanding that after bids were opened by the architect the figures filed with their association would be available to every member and that no contractor other than the low bidder should submit additional figures for modification unless such modifications amount to over 50 per cent. of the figure bid.

In another case it was understood that the first, second and third bidders submit figures on modifications.

In still another instance, the contractors refused

No. 88

Canada's Engineers—T. S. Scott

Thomas Smythe Scott, who was appointed city engineer of Niagara Falls, Ont., last August, was born in Glenmorris, Brant County in 1871, and was educated at Galt Collegiate Institute and Queens University, Kingston, from which he graduated in Arts, in 1894. Three years later he received the B.Sc. degree after completing the course in civil engineering. In the year of his graduation Mr. Scott went to southern British Columbia to report on a hydraulic mining scheme, a year later joining the G. T. R. as foreman of construction of a new yard. The following spring he was transferred to the general roadmaster's office as chief clerk and was later placed in charge of a switch gang, and subsequently became roadmaster.

In 1901 he resigned this position to become instrumentman for the Canadian Niagara Power Co., later joining the Ontario Power Co., as field engineer having charge of their construction work. In 1904 Mr. Scott was engaged as manager by Battle & Phin, the contractors on the rock excavation work for the Ontario Power Co., and the following year he was chosen as the mutual representative of the contractors and the company to complete extensions at the Canadian Niagara Power Co.'s plant. During 1905 and 1906 he was employed as manager by the contractors for the high-tension transmission line from Rochester to Syracuse, N.Y. After that engagement Mr. Scott was in charge of the construction of the Shawinigan Falls tunnel, returning to New York State in 1908 to become manager for a contractor who was constructing macadam state-roads. In the latter part of 1908 he again undertook railroad work, being appointed mutual representative of the contractors and the Ontario government as manager of extension of the T. & N. O. railway to Cochrane, Ont. Upon completion of this work Mr. Scott was appointed principal assistant to the city engineer of Toronto, and was in charge of all construction work on roads, sewers and bridges. He resigned that position in 1910 to become president and general manager of the Columbia Bitulithic, Ltd., Vancouver, and during the next four years he built the Granville St. pavement and many other well-known bitulithic roads and streets in various parts of British Columbia. In 1915 Mr. Scott accepted an appointment as acting professor of civil engineering at Queen's University, later becoming professor of highway engineering. In 1920 he resigned to take up contracting work. During the war he was in charge of the Fifth Field Co., Canadian Engineers, at Halifax, managing the engineering services at the various forts and clearing depots in that district.

Mr. T. S. Scott

to alter their proposals and would not submit figures on modifications until after the contract had been awarded

Going on the assumption that all who are competing would act in a business-like manner, the low bidder could submit a revised proposal based on minor changes without further cut in his estimated profit. He could persuade his competitors to refuse to submit further bids as long as he was low.

Winter Construction

Men in the building industry, from material manufacturer to carpenter and mason, have long known the economic advantage of building in the "slack season". For several years the industry has waged a steady campaign to bring this fact before the public and spread the congested activity of a few months over the entire year.

When the greater portion of building is crowded into seven months, prices reach their highest in the spring and summer when the demand crowds supply. The same situation obtains in the labor phase of the work.

By building in the fall and as far as possible into the winter, this demand is more nearly proportioned among 12 months of the year; mills and factories are able to maintain a steadier flow of production; raw material is stabilized; workmen are not shifting jobs so often, and the contractor and architect are able to keep their basic organizations intact, thus decreasing overhead expenses and assuring more satisfactory and efficient work.

Men in the industry see in this autumn's increased building, the prospect of a broadening of the old short season and a consequent stabilization of building costs, estimating that the certain success of the home owners who are building this winter will prompt many others to take the step in succeeding seasons.

The manufacturers of cement particularly have waged steady campaigns on this one subject, in perfecting methods of using their product in cold weather to the best advantage, and to bring a realization of the savings to be effected before the public.

That such campaigns have borne fruit is evidenced in reports for proposed construction from many cities which show a greater volume of all classes of building on the books for fall and winter than ever before.

Placing Concrete in Winter Weather

Successful Concrete Operations in Low Temperatures Depend on the Use of Proper Methods—Portland Cement Association Booklet Describes the Essential Features

In order to place concrete successfully in cold weather, it is necessary to be prepared to use somewhat different methods than in summer months. The fundamentals of these methods are easily comprehended by an understanding of the action of concrete in hardening.

Hardening of concrete is not a process of drying out as some people suppose, but is a chemical reaction between the cement and the water used in the mixing. Two things are necessary for proper hardening—namely, warmth and moisture.

Low temperatures will retard the hardening of concrete, extreme cold will prevent it altogether. Since water is necessary for the chemical action of hardening, evaporation of the water used in mixing the concrete must be prevented. This is often done by keeping the surface covered with wet sand, sawdust or burlap. As the temperature is lowered and the moisture content is reduced, the gain in strength and the entire hardening process become much slower and practically cease when the temperature of the water used in mixing falls to the freezing point.

If concrete that has frozen is thawed out and protected from freezing again, it will harden properly providing no appreciable loss of water used in the mixing has occurred. In this case, the hardening process is merely suspended during the frozen period. However, if alternate freezing and thawing occur several times, the concrete will be seriously injured and may have to be torn out. The exact period that may be allowed to elapse between placing concrete and subjecting it to freezing temperature cannot be definitely stated because of the influence of unknown variations in temperatures and other conditions. However, experience shows that this period should never be less than 48 hours and if the temperature averages below freezing 3 to 5 days should be allowed.

Method for Winter Work

Since warmth and moisture are required for the proper hardening of concrete, cold weather work should be planned with those necessities in view. The methods to be used on any particular job depend, of course, upon the local conditions. Both the mixing water and the aggregates should be heated. The cement forms but a small portion of the concrete and need not be heated, but it is well to keep it in a warm place for a few hours before it is used.

The nearer the water is to the boiling point the better will be the results because it will take longer to dissipate the heat and cool the mixture. There are several types of water heaters that can be used, but the most common method of heating is to pass steam into the water tank. The concrete should be mixed with the least amount of water practicable to produce a workable, plastic mixture. An excess of water should be carefully avoided.

Many methods are used for heating aggregates. A simple method is to use a length of iron pipe, an old boiler, or any metal cylinder over which the sand, broken stone, or pebbles can be piled, and in which a fire can be built. Care must be taken to heat the fine and coarse aggregates separately in order to avoid pre-mixing them in wrong proportions. As this method entails rehandling the aggregate, and as some aggregates are affected by excessive heat, the use of steam pipes is generally preferred.

Steam heating is a more expensive method and requires a steam boiler, but on large jobs this method is usually advantageous because the steam may also be used for other purposes. A practical method is to use a perforated steam pipe with a pointed end which can be worked into the piles of aggregates. To reduce loss of heat the piles of aggregates should be covered with tarpaulin.

If the materials are heated as above outlined, and the concrete is deposited immediately after mixing, its temperature when placed in the forms will be around 80 deg. F. and if care is taken to prevent too rapid loss of this contained heat, the concrete will harden properly. The early stages of hardening may be even more rapid than under ordinary conditions.

Heating the Forms

The forms must be free from snow, ice and frost, and should also, if possible, be reasonably warm, especially in the case of metal forms, which will absorb heat from the concrete rapidly. Live steam is an effective agent for cleaning ice, etc., from the forms. and warming them. It should be used just before the concrete is placed.

Protection and Supplying Heat While Hardening

A rapid loss of contained heat must be prevented. Protect the concrete while hardening so as to maintain the warm, moist condition essential for the rapid development of strength. There are many methods of doing this: the most common is an enclosure of canvas or tarpaulins. In mild weather this alone may be sufficient, but when the temperature drops below the freezing point, some means should be provided for heating the enclosure. Steam escaping from perforated steam pipes around the concrete will give the best results, because the steam saturates the air and prevents evaporation of moisture from the concrete.

Coke salamanders or stoves are often used when steam is not available to supply warmth to the enclosure, but large pans of water should always be placed on or near them in order to provide as much moisture in the air as possible. Care should be taken not to have these stoves or salamanders so close to the concrete as to dry it out in spots. An even temperature of at least 60 deg. F. should be maintained at all times in all parts of the enclosure. To maintain this temperature within a properly housed enclosure during cold weather, it may be estimated that with good coke properly handled one salamander will be required for every 300 to 500 sq. ft. of floor area.

In some cases the entire structure has been enclosed in a temporary wooden building but in general a canvas covering will be cheaper and just as effective. For retaining walls and similar structures a light roofing paper envelope placed outside the forms with steam pipes at the bottom has proved satisfactory.

Protective Coverings

When it is warm during the day with a temperature drop close to the freezing point at night, floors, pavements and foundations are often protected by covering with straw, hay or other material with satisfactory results, but such covering should not be relied upon during protracted low temperatures.

Even though the outdoor temperature may drop to freezing, suitable protection is necessary to prevent the concrete from losing the heat introduced by heating the materials, and insure proper hardening. At low temperatures the heat developed by the chemical reaction of the cement and water is too small to be safely relied upon except in large masses underground. Even in those cases the materials should be heated and the surface protected.

Thin structural members and floors have such a large surface area in proportion to their size and the heat within the concrete is dissipated rapidly, and therefore protection must be provided.

Application of Load

Too early removal of forms is always to be guarded against even during construction in favorable weather, and great caution should be observed in placing loads upon cold weather concrete. Especially is this true of walls, roofs and floors above ground, which carry loads other than their own weight.

Before removing forms the concrete should be examined to see that it has properly hardened and not frozen. A reliable test is to apply heat to the surface by means of a blow torch or a jet of hot water or steam against it.

Frozen concrete will be disclosed by softening as it thaws out, but if properly hardened, the concrete will be unaffected by the application of heat.

Summary of Important Points

Points that should be observed in cold weather concreting are summarized as follows from the instructions to superintendents of the Turner Construction Co.:

Aggregates are heated to best advantage by 1½-in. steam pipes laid as a grill under the piles or by a 6-ft. length of perforated pipe insert, inserted into the pile.

Water is heated by running a 1½-in. steam pipe into the water barrel.

A 50-hp. boiler, carrying 50 to 60 lbs. of steam is required for a large job, but an 18 to 25-h.p. boiler is sufficient for jobs of not more than 5,000 sq. ft. of floor area.

One salamander is usually sufficient for 300 sq. ft. of floor area and a heat hole should be provided for each salamander.

Columns should be concreted the same as the floor and column tamping continued for an hour or more after the floor is concreted.

Bases of exterior columns are most difficult to protect and in extremely cold weather a salamander should be placed on two sides of exterior columns.

For unusual speed or cold weather or when monolithic walls are carried up, the lower floor should be curtained and salamanders placed at exterior columns.

Apply fuel to salamanders frequently and in small quantities to minimize smoke and provide uniform temperature.

Water barrels should be provided to extinguish fires and care taken to secure against blowing against salamanders.

A detailed temperature record should be kept showing date, hour, outside temperature, temperature at bottoms of columns, underside of slab, under the canvas over the slab, temperature of concrete as deposited and, especially, temperature at bases of exterior columns on windward side of building.

Re-union of "School" Grads

Engineering Alumni of the University of Toronto Gather for Two Days of Social and Business Activity

"School spirit!" To those around the University of Toronto the mention of the words "School Spirit" implies something tangible, something concrete. the link, invisible, though it is, which binds one Schoolman to another and stamps a graduate of School with an indestructible mark so that he is recognized wherever he goes.

And so when it became known that the Engineering Alumni Association of the University of Toronto would hold their fourth annual re-union, on October 27th and 28th, graduate engineers from the old School of Practical Science from all over the Dominion and the United States assembled in this city to renew friendships and visit once more the scenes of their college days.

The programme as arranged by the executive of the Alumni, was indeed a complete one, opening on Friday noon with class luncheons. On Friday evening a dinner dance was arranged in the Crystal Room at the King Edward Hotel. Extra dances between courses were enjoyed, dinner being served at tastefully arranged tables around the walls of the ballroom. Some twelve dances, lasting until midnight completed what was possibly the most delightful evening ever spent by the graduates of School. Saturday morning, the year meetings were held at Varsity, all the classes from away back in the eighties down to last year, being well represented.

As a result of the business meeting, federation of the Engineering Alumni Association with the Alumni Association of the University of Toronto is a probable outcome. The proposals for affiliation were submitted by the University Alumni, and the general sentiment of the meeting was strongly in favor of acceptance, consequent upon some minor changes being made by the executive of the Engineering Alumni.

A buffet luncheon was served in the Thermodynamics Building after which the graduates gathered in their reserved section at the Stadium to witness the Queen's-Varsity football game.

After the game, the Alumni were the guests of the staff of the Faculty of Applied Science at a reception held in the Thermodynamics Building. Tea was served and a pleasant social hour was passed.

The crowning event of the re-union was the annual dinner held in Convocation Hall where the maxim "For it's always fair weather when School men get together" was successfully proved. The dining-hall was beautifully decorated, separate tables being provided for each year and marked by gas-filled balloons.

After the dinner and the toast to the King, Capt. C. E. MacDonald proposed the toast to the University of Toronto. In replying Prof. A. T. DeLury of University College, made reference to the Literary and Scientific Club of olden days and said that the Alumni Association was rapidly forming closer bonds between School and the rest of the university. In replying to the toast to the Engineering Profession, Dr. A. C. Humphries, President of the Stevens Institute of Technology, Hoboken, N. J., laid stress on the point that students should be properly prepared in the essentials before commencing an engineering education. Prof. H. E. T. Haultain of S. P. S. proposed the silent Toast to those graduates who were killed in the war, which was followed by "The School" by W. E. Douglas of the class of '02, and replied to by Dean Mitchell of the class '92. General Mitchell appealed to the alumni for scholarships saying that it was only by the individual and co-operative efforts of the association that scholarships could be provided, and that it was in this respect that the alumni could best help the student of today.

Mr. T. Arthur Baker of New York was in charge of the singing and the general entertainment throughout the evening. Undergraduates of the school also provided amusement with a programme that consisted of several songs by the School quartette, comic solos, two splendidly contested boxing matches between Seaborn and Maguire (heavyweight) and Erving and Schemnitz (lightweight); a wrestling match, Murray vs. McLellan; and incidentally a burlesque boxing match between two students carrying the aliases of Prof. C. H. C. Wright and Prof. J. Roy Cockburn which was won by Prof. Wright on a kick to the dead line.

This brought the S. P. S. re-union to a close, the great success of which was, in a large part, due to the executive of the Alumni, but also to that binding influence which still brings School graduates together, namely,—School Spirit.

Drawing to Show Timber Construction Details

In connection with the preparation of a new series of publications for architects, engineers and builders, the National Lumber Manufacturers' Association has had some drawings prepared showing the details of timber construction for a one-storey mill building with a timber saw-tooth sky-light construction. An excellent example and good details have been secured and it is felt that this information will be of value to the architect, since this type of construction is difficult to detail.

It is also proposed to develop a number of plates on the use of heavy timber in railroad structure for distribution among the railroads, in the opinion that such information in proper hands, would turn the tide in favor of wood in the construction of shop buildings, blacksmith shops, round houses, etc. The life of heavy wood roof construction in blacksmith shops, or round houses, is five to ten times that of steel trusses, nevertheless, in modern buildings of this class, the tendency seems to be to use steel.

Erection Features on Kenogami Bridge

Steel Structure Recently Completed Over the Saguenay River Required Cantilever Erection—Cableway Used for Handling of the Steel—Log Sluice Carried on Brackets

By F. T. COLE

Chief Engineer, Eastern Canada Steel and Iron Works, Ltd

The steel erection of a bridge over the Saguenay River at Kenogami, P. Q., has recently been completed. This structure, several aspects of which are illustrated herewith, has several points of special interest. For one thing, the location is at a point where the steel could be delivered to one side only and had to be taken across on a temporary cable-way. The bridge is in the centre of a long stretch of rapids with no road on the north shore, and the current and depth of the river necessitated cantilever construction for the erection. Fig. 1, shows the erection in progress together with the cable-way in the fore-ground.

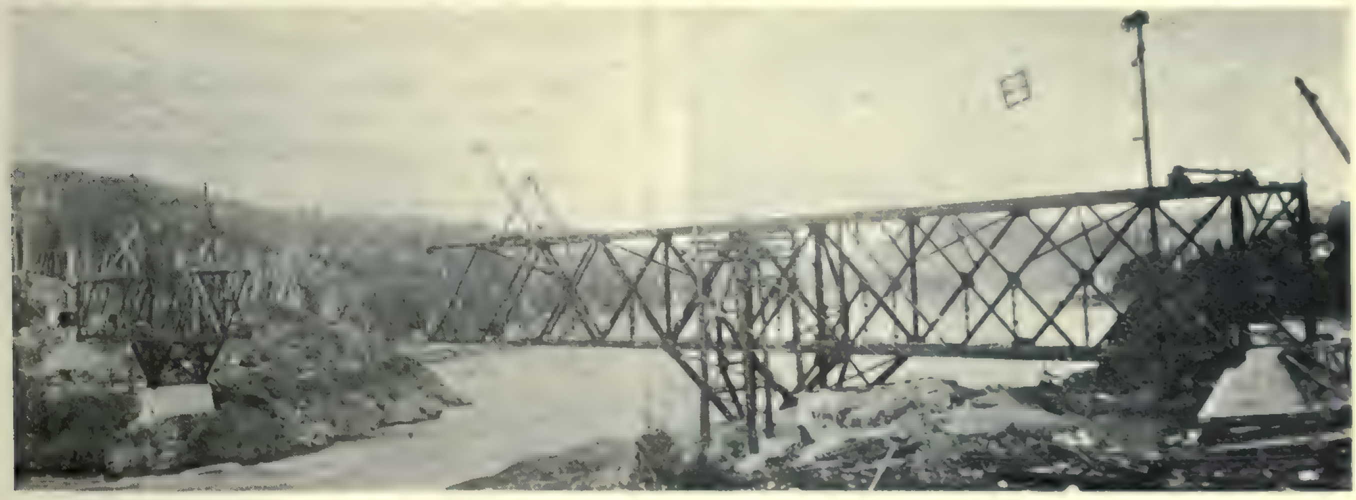


Fig. 1—The bridge over the Saguenay river at Kenogami, during erection

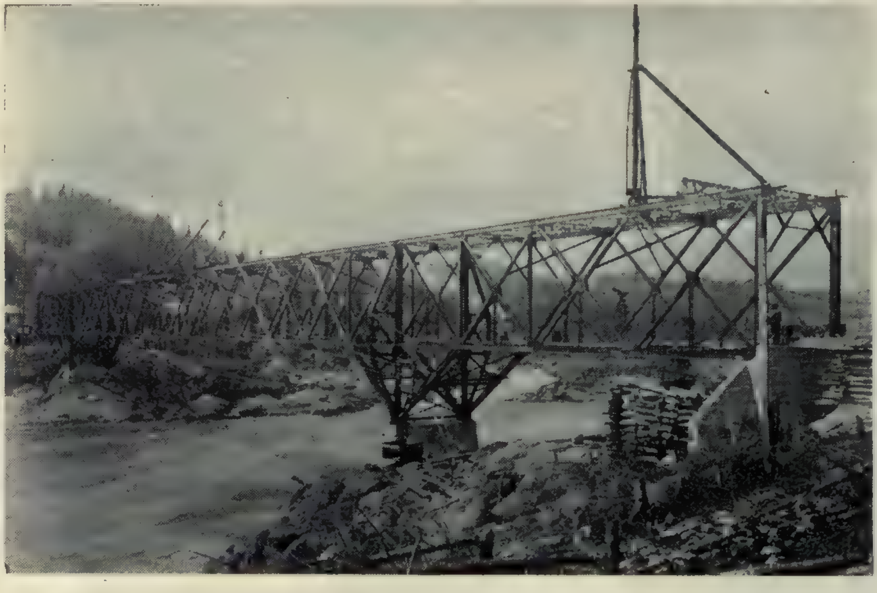


Fig. 2—Making the centre connection on the Saguenay river bridge at Kenogami, P.Q.

The design decided on was a double intersection bridge continuous over four supports with negative reaction at end piers; this giving the lightest single members for cable-way transport, and permitting necessary cantilever erection. The ends were held down by eye bolt rods extending through the posts to top chord, to give free access to the nuts for adjustment after erection. Diagram No. 1, Fig. 3 gives the camber when the centre connection was made but no stress was taken at the centre point. No. 2 is with the ends swinging free and No. 3 is the final condition with the ends loaded to relieve the centre stress. Fig. 2 shows the centre connection being made, while Fig. 4 shows the log sluice which is to continue on cantilever brackets on the side of bridge. This bridge was built for Messrs. Price Brothers & Company, Limited, Kenogami by the Eastern Canada Steel & Iron Works, Limited, Quebec.

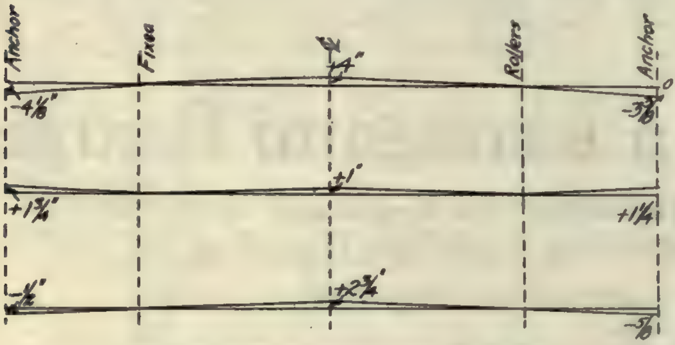


Fig. 3—Camber at different stages of erection

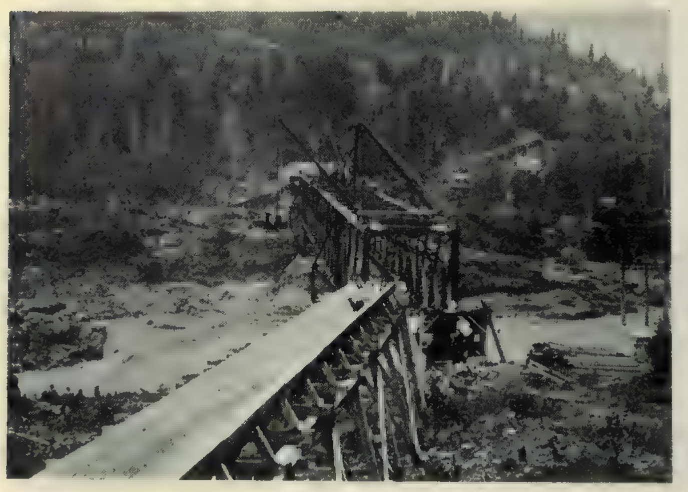


Fig. 4—Log sluice which is continued on brackets on the side of the bridge

New Line of Spray Equipment

The DeVilbiss Mfg. Company announces a new series of DeVilbiss portable spray-painting equipment. This is an improved and reliable line with which to meet any large or small painting requirement from interior decorating to the largest building or structural job. These new portable outfits, along with the wide range of DeVilbiss industrial finishing room equipment, makes it possible to fill practically any need in painting or finishing either structural work or manufactured products. They have issued an attractive illustrated folder, describing this new series, which will be sent on request.

Let's Keep Building Going all Winter !

There is no excuse for anything less than a twelve-months' construction season—except the excuse of bad habit.

There is no reason why the winter months should not take some of the burden of keeping things going.

It can be done and is being done every year by builders and contractors who know the profit of keeping their efficient organizations together and working.

Let's all do it.

Co-operation of Engineer and Contractor

The Extent of the Engineer's Duties and Authority—Ignorance and Inexperience Breed Misunderstanding—Poorly Equipped Contractors Cause Lack of Harmony

By **W. R. NEAL**

Read before a meeting of the Southern District of the Asphalt Association

This is a subject very often under discussion by all of the parties concerned. The engineer has his interpretation of the word co-operation, the contractor his and the owner his; but isn't it a fact that each one's idea about just what this word means is a little different? This reminds me of a story told me by a friend. He relates that soon after marrying, he, wishing to avoid mistakes commonly made by married people, decided it would be a good idea to have a frank discussion with his wife in order that they arrive at a plain understanding of their relations. After a brief discussion, mostly carried on by him, they agreed that as he was the man all very weighty matters would be decided by him and that everything else would be decided by the wife. He relates that after several years of married life nothing of a real serious nature had come up for his decision and as a consequence his wife had decided everything.

In regard to the subject under discussion most specifications frankly place upon the engineer all of the decisions in the carrying out of a contract. It is my belief, however, that the engineer has, generally speaking, fully realized that this authority is not given him to abuse. Fairness to both the owner and the contractor should be the goal which the engineer strives for.

My experience in life has been that almost every one wishes to be fair according to his own lights, but I must admit that I have met some people with very dim lights. My experience has also led me to believe that, generally, misunderstandings are brought about by the ignorance of someone connected with the undertaking.

Frequently contractors submit bids without either a thorough knowledge of the specifications or of the site where the work is to be executed. It is also a fact that frequently misunderstandings arise, due to the fact that the engineer is either unfamiliar with the terms of the contract and the specifications, or that he is so inexperienced that he is not capable of properly interpreting same.

The Engineer's Duties

The first lesson to be learned by the engineer is, that he is not only representing the owner, but that he is also representing the contractor. Fairness to these two parties is the engineer's job. First, it must be recognized that the owner or beneficiary should pay the full cost agreed upon for the improvement. Second, that the contractor effecting the improvement should receive a fair compensation for his efforts, insofar as the limitations of the contract will permit. It should be the desire of the engineer to so assist the contractor that after the proper execution of the work a maximum profit can be made. It should be the desire of the contractor to so perform his work that nothing, either in the spirit or the letter of the contract, remains to be done towards securing for the owner a satisfactory job. With both the engineer and the contractor entering into their work with this spirit, true co-operation may be expected.

The laws frequently prevent the awarding of the contracts to the best bidder; frequently there are written upon the statute book maximum salaries to be paid engineers, thus preventing the state or county from securing the very best engineering service. Very often you find a resident engineer or a division engineer in charge of a great many construction jobs and clothed with full authority, who may or may not be competent and who frequently is paid less money than the foreman of the construction gang.

Adequate Remuneration

Contractors are always on the lookout for good men and good men are always on the lookout for a means of bettering their positions in life; therefore, it is imperative not only from the interests of the owners but also, from that of the contractor that adequate salaries be allowed in order to secure and hold competent, experienced engineers. Not only is this true of the engineer but it is true of the contractor. A well equipped contractor receiving a fair compensation for his work, with an experienced engineer, (and generally this means an engineer receiving a fair salary) in charge of the work, means a smooth running, harmonious job where real co-operation and satisfactory results to the owner may be expected. On the contrary a poorly equipped contractor who has submitted a bid which will not allow of a first class job with a fair margin of profit, means contentions, and either the slighting of the job or calling on the bondsman, and this always means delay and ultimately a poorly finished job and a dissatisfied public.

Unfortunately all engineers are not to be entrusted with the wide powers generally given the "engineer" by the specifications. There are in every profession what corresponds to the "shyster lawyers"—that is a man who lives by making trouble. Many men employing engineers think that trouble between the contractor and engineer is to be expected and unless there is some trouble, that the engineer is not looking after the job properly or is "in with the contractor." With this before them there are engineers who are unscrupulous enough to make constant trouble for the contractors; the result is loss to all contractors working under them or excessively high prices for work. The only remedy for this, in my opinion, is for reputable contractors to investigate the engineer in charge of work and in case his reputation is not good, to refuse to bid or work in his charge and to inform the men who employ the engineer the reason for declining to bid. Bonding companies could be required by the contractors to furnish impartial information in regard to an engineer, standing and reputation.

Another cause of trouble is placing an inexperienced engineer in responsible charge of work. Owners will employ a graduate engineer just out of college. The man may be entirely sincere in his efforts but through lack of knowledge of actual construction conditions he may, by over emphasis of some unimportant point cause a loss or at least unnecessary trouble without bettering the job in the slightest.

The Incompetent Contractor

A phrase of this subject which I consider a real serious one is the insistent bidding of contractors both poorly equipped and incompetent to perform a first class job, but who can get bond. This class of bidder is a constant menace to the other contractors as well as to the engineer's reputation. Of course, you know how difficult it is for a public official to reject the bid of this class of contractor. In selecting any other than the lowest bid, the public official is immediately accused of partiality and even of graft.

The inspectors and the resident engineer are supposed to be able to enforce the carrying out of the plans and specifications and secure the same result regardless of what class of contractor is doing the work. Yet, anyone at all familiar with construction knows how utterly impossible this is. To obtain first class results experienced, well equipped contractors and competent, experienced engineers and these co-operating to the best interests of the owner are absolutely necessary. Now, how can this be accomplished? In my opinion, the only practical way is for the engineer to reject all work not coming jam up to the plans and specifications.

If this is plainly understood, the result will be that contractors who are not equipped either with machinery or experience will either be deterred from bidding or very soon driven out of the contracting business. In order to carry out this plan successfully and with every assurance of fairness, specifications must be plainly written and competent engineers and inspectors placed in charge of the work.

Large School at Maisonneuve, P. Q.

The St. Aloysius School is Thoroughly Fireproof in Construction and is Handsome in Appearance—To Have Twenty-eight Rooms

The new St. Aloysius school, Maisonneuve, P.Q., is situated on Adam St., between Pie IX Blvd. and Desjardins St. and adjacent to the church. When the annex will be built on Desjardins Street, in the near future, this school will have 28 class rooms, two manual training rooms and one for domestic science. Nineteen classes are in the building already erected, and it will accommodate 760 boys and girls. It is of beautiful appearance and a building in which the people of the district may be justly proud.

It is four stories high and basement, and of reinforced concrete construction with walls of brick and stone, and, therefore, of a fireproof nature. An added fire precaution inside are the two large iron stairways, with slate treads, beside an adequate supply of outside fire escapes in the rear.

Besides the nineteen class rooms there are two recreation rooms, fine toilet rooms for boys and girls on each floor, also a large cloak room for each class. There are also two teachers' rooms, a principal's room and public hall.

The ventilation is modern and of the best. There is hot water heating. Another health promoting feature of this school is the installation of a complete and modern vacuum cleaning system. The floors are of fine well-surfaced birch hardwood throughout, and possess a very good appearance and easy to clean. Quarters are provided for a resident caretaker.

The architect for this building is Mr. Irenee Vautrin, 30 St. James Street, and the contractors are Messrs. A. Gratton and Gratton and Girard. The members of the Board of Catholic School Commissioners, East District, who control this building are: director-secretary, Mr. J. H. Manning; president, the Rev. J. A. Contant; the Rev J. A. Piette, Mr. Oscar Senecal,, Mr. Edgar Richard, Mr. Jos. McLaughlin, Mr. N. Cordeau.

This school has been built to the entire satisfaction of the commissioners at a cost of $167,600.00. The extension will cost in the neighborhood of $75,000.00.

The St. Aloysius school in Maisonneuve, P.Q., which, when extended, will have 28 class rooms.

A New Method of Purifying Water

The Use of Slow Sand Filters Treated With Aluminum Hydroxide—Many Advantages Over Other Methods are Claimed and Only One Drawback—Lower Precipitant Cost

A new method of purifying water was described by Harry W. Clark, chief chemist of the Massachusetts Department of Health, at the recent meeting of the New England Water Works Association, the method consisting of the use of slow sand filters treated with aluminum hydroxide. This method was said to cut the cost of precipitant from the five to six dollars per million gallons required for rapid sand filters to fifty-five cents per million gallons, or less. In answer to a question, Mr. Clark stated that the hydrogen-ion value was increased by this treatment. He also stated that hydroxide precipitated slowly as the water containing the solution was held in the filter and the precipitate coated the individual sand grains. His paper is as follows:

Probably the chief objection to slow sand filtration in the minds of many sanitary engineers and waterworks officials is that this method of water treatment seldom removes from the comparatively clear but often highly-colored waters on the eastern States more than from 25 to 30 per cent of this color, and hence does not produce a filtrate as clear, sparkling, low-colored and altogether attractive as the filtrate from coagulation and rapid filtration of such waters. On the other hand, perhaps the chief objections to the method of coagulation and rapid filtration when applied to these soft, highly-colored waters, are the tendency of this method to increase the corrosive properties of the soft water treated, the difficulty with which as good bacterial results can be obtained by it, generally speaking, as by slow sand filtration—especially if these soft waters are badly polluted, and the fact now again being widely commented upon that occasionally aluminum sulphate does pass through such filters.

Owing to these objections or criticisms of the two methods, a process of water treatment that will produce a sparkling water of low color without materially increasing its corrosive properties has been much desired, and such a method, I believe, we have worked out at the Lawrence Experiment Station of the Massachusetts Department of Public Health. I am calling this a new method, although we have been experimenting with it since the latter part of 1916, and have published in our reports short summaries of the results obtained.

Briefly, the process consists of loading the sand of a slow sand filter with the ordinary coagulants used in mechanical filtration and operating such a filter generally at slightly more than the usual sand-filter rates, or about 5,000,000 or 6,000,000 gallons per acre daily. Filters loaded in this way remove a very large percentage of the organic matter, especially the coloring matter of the applied water, produce an effluent clear, sparkling and altogether attractive, containing no more carbonic acid than in the raw water applied to the filters and with the carbonic constituents of the water slightly increased.

Only One Drawback

This method of water treatment has many advantages over each of the other methods and but one drawback. The advantages are as follows:—

(1) The corrosive properties of the effluent are not increased, or, if so, not materially, and neither aluminum sulphate nor alumina is found in the filter effluent.

(2) The aluminum hydroxide with which the filter is first loaded is regenerated whenever its color-removel properties begin to fail, and hence is used over again—that is, the primary cost of coagulants is practically the final cost.

(3) When receiving comparatively highly-colored water from storage reservoirs practically free from mineral matter in suspension, such as silt, &c., the method of filter regeneration or removal of stored color which we employ removes practically all organic matter from the surface of the filter as well as from its deeper portions, and hence the necessity for scraping the filter is largely obviated—that is the expense of sand removal and sand washing is reduced to a minimum. Filters of this type now in operation at the Experiment Station have been scraped only once or twice during a period of five years' operation at rates of 5,000,000 gallons per acre daily.

(4) There is, as I have already stated, practically no consumption of alum. Filters operated now for five years have theoretically used up to date—taking into consideration the amount of aluminum sulphate primarily placed in the filter and the volume of water filtered—about .2 of a grain of sulphate per gallon of water filtered, or practically one-twelfth of the amount necessary per gallon in successful mechanical filtration of the Merrimack Rives water such as applied to these loaded filters. As the loaded filter increases in age and the volume of water filtered and decolorized increases, the theoretical or apparent use of alum grows less and less per gallon.

Successful mechanical filtration of Merrimack River water costs in the neighborhood of $6 or $7 per 1,000,000 gallons for aluminum sulphate, while with this new method the cost to date has been about 55 cents per 1,000,000 gallons for this sulphate, and this cost is constantly growing less—that is to say, if in the next five years we filter as large a volume of water as in the past five and without additional loading of the filter, the cost will be 28 cents per 1,000,000 gallons.

Results of Filter Operation

Up to date we have operated eleven filters loaded with aluminum sulphate, but for purposes of this paper the results of only five or six need be given. One filter put into operation in January, 1917, and constructed of 4½ ft. in depth of sand, with an effective size of .25 millimeter, was loaded with 80 tons of aluminum sulphate per acre of filter surface. The aluminum hydroxide was precipitated in the sand by flooding filter alternatively with small doses of solutions of soda ash and sulphate, although the filter can be loaded by mixing an alkali such as magnesium carbonate with the dry sand and then applying solutions of the sulphate. During its five years of operation the average color of the effluent from this filter has been 14, and the color of the water applied to it 41—a removal of 66 per cent. During long periods the color of the effluent has averaged 7, however, and during portions of these periods the applied water has had a color of 60, 70, and even 75—that is, the filter has given an average color removal during such periods of about 90 per cent. In other words, the color line of the effluent has always been nearly straight, while the color of the applied water has had many high peaks, and the higher the color of the applied water the greater the percentage of the coloring matter removed. Up to date this filter has removed rather more than 50 per cent of the organic matter determined as albuminoid ammonia and 60 per cent of that determined as oxygen consumed. It has been treated with weak solutions of caustic soda twenty-four times in five years in order to remove the coloring matter held in the filter by the aluminum hydroxide. After this treatment with caustic such a filter is washed with a volume of water equal to about 2.5 to 3 per cent of that filtered between treatments, and is then ready for service for a period of two or more months It is not necessary to use filtered water for this washing out of caustic. The amount of caustic used up to date in the filter described has been .5 of a grain per gallon of water filtered, or, in other words, the expense for the caustic used has been about $2.50 per 1,000,000 gallons of filtrate. We believe, however, judging from later results, that we have used in this particular filter an excessive amount of caustic and that this figure may be much reduced. A filter loaded with 150 tons of aluminum sulphate per acre has given an average color removal of 78 per cent during the past two years when operated at a 5,000,000 gallon rate, and a filter constructed of sand as fine as .11 millimeter effective size and operated at a 2,500,000-gallon rate has produced an absolutely colorless effluent since first put into operation. The cost of efficiently loading an acre filter is a small percentage of the cost of filter construction.

The bacterial results from this method are poor, as the caustic used removes from the sand grains much of the gelatinous organic matter so necessary for the retention of bacteria, but the effluent—clear, low in color and sparkling—is easily rendered practically sterile by the use of small amounts of chlorine, and chlorine is in almost universal use at filter plants at the present time, in order that their effluents may be absolutely safe.

Applicable to Highly Colored Waters

This method of treatment is particularly applicable to stored waters of a high color, the improvement of which physically is of more moment than the reduction of bacteria, and it has seemed to us that there is no serious objection to it which would prevent its use upon a large scale. Recent experience has shown that perhaps the better way of loading the sand would be to carry this loading process on in comparatively small tanks or bins and then transport the sand to the filter. By this method more even distribution of the hydroxide would be obtained and stratification prevented.

The following table illustrates some of the results obtained at the Experiment Station during the past five years:—

	Filter No. 1.	Filter No. 2.	Filter No. 3.	Filter No. 4.	Filter No. 5.	Filter No. 6.
Tons of aluminum sulphate precipitated in filter	80	75	75	150	150	225
Color removed (per cent)	66	73	73	73	78	76
Number of days between caustic treatments	65	67	67	89	89	90
Grains of caustic soda used per gallon of water filtered	.52	.21	.42	.16	.32	.16
Approximate percentage of wash water	2.5	3.7	3.7	2.8	2.8	5 5

Rate of each filter 5,000,000 gallons per acre daily

Tests Determine Effect of Alkali

Concrete Drain Tile and Blocks are Reported to Suffer From Exposure to Alkali Laden Soils—Importance of Good Materials and Workmanship

The behavior of concrete drain tile and concrete blocks in alkali soil are reported in the third progress report of a group of engineers under the general direction of the United States Bureau of Standards in Technologic Paper No. 214 of the Bureau, entitled "Durability of Cement Drain Tile and Concrete in Alkali Soils: Third Progress Report (1919-1920)." It is by G. M. Williams, who was at that time associate engineer of the Bureau of Standards, and was written in co-operation with consulting engineers and representatives of government departments as well as a representative of the Engineering Institute of Canada, the Portland Cement Association and the American Concrete Pipe Association. The tile under study were placed in 1913 in eight alkali bearing districts in the West. According to the conclusions the best quality of concrete will disintegrate when exposed to severe alkali attacks and installations of concrete in soils containing more than 0.1 per cent of salts of the sulphate type should be preceded by an examination of surrounding conditions.

Drain tile of 16 varieties were installed in working drains in western states, five additional types have since been provided to replace tile removed for tests. A large number of concrete blocks were also molded and placed in alkali waters. Variations in brand of cement and preparations of concrete as well as types of manufacture were made. Early inspections showed that both the tile and the blocks were seriously affected by alkali attacks. The 1919 field investigation showed that in general the condition of the tile was quite similar to that found in 1916 and that average strength results as well as appearance of the tile with respect to salts in the walls had not been greatly changed by three additional years' exposure.

It is stated that durability of concrete drain tile for any given concentration appears to vary with the richness of the mix and consistency. Hand-tamped tile are less resistant to action than machine-made tile made of the same mortars. Tile made with sufficient mixing water to result in such a consistency that they must be retained in the molds for several hours have proved more durable than richer mix tile of the machine-made type of such a dry consistency that the jacket may be stripped immediately. As a class it may be said that wet mix tile have been much less affected by alkali action than dry mix tile.

Inspection of drain tile and concrete structures in other localities where the alkali salts are of the chloride or carbonate types seems to justify the conclusion that these waters are not so severe as waters of the sulphate type which are found in all of the drains in the alkali districts. In waters of the sulphate type severity of action appears to vary with the concentration of soluble salts. For the concrete blocks somewhat the same observations are made and the additional one that with the same aggregates lean mixtures are more seriously and rapidly affected than rich mixtures. Durability appears to be dependent upon impermeability, which is mainly dependent upon richness of mix and gradation of aggregates.

Conclusions

The following are the conclusions in the paper:

1. Results to date indicate that materials of good quality and proper workmanship are of great importance in the production of concrete which is to be exposed to alkali soils and waters.
2. Action noted on surface of concrete blocks of best quality after one year exposure in sulphate waters has in most cases been progressive, depending upon conditions of exposure.
3. Extent and rapidity of disintegration in sulphate waters depends upon concentration of salts in waters to which the concrete is exposed.
4. In blocks containing reinforcing rods disintegration appears to be aided and accelerated in some cases by corrosion of embedded steel and consequent cracking of the concrete, as has been observed in some reinforced-concrete structures exposed to sea water.
5. Structures placed in alkaline soils or exposed to alkaline seepage waters should be given all possible protection by drainage.
6. Seepage waters and alkaline soil conditions may be encountered which will disintegrate concrete of the best quality, and proper consideration should be given to soil and water conditions and protection by drainage and other means when it is proposed to expose concrete structures to conditions similar to those in which these test blocks have been placed.
7. Alkali salts are not uniformly distributed throughout the soil or large bodies of seepage waters, and it will be difficult to determine in advance the concentrations to which a structure may be later exposed. A systematic scheme for sampling soils will furnish information as to the quantities and types of salts available for solution, while analyses of seepage waters will indicate the concentrations present at the time of sampling. Disintegration is brought about only by those salts which are in solution as indicated by analyses of water samples, while the soil analyses merely represent reserve supplies which may bring about changes in the existing solutions with changing conditions of rainfall, flooding, etc. The problems of drawing conclusions as to the most severe conditions which may occur becomes more difficult when the source of supply of the salt is through underground seepage from some distant point.
8. For the same concentration of soluble salts, and for the same aggregates, resistance of mass concrete to alkali action appears to vary with cement content or richness of mix, within the limits employed in these tests.

Highways Across the Rockies

Engineers of the Canadian National Parks Branch announce that the Vermilion-Windermere section of the new motor highway across the Rockies from Calgary is now nearing completion. This road forms the last link in the through highway from Calgary to California, the opening of which is being eagerly awaited by motorists in both Canada and the United States. As soon as it is open a circle tour of 6,000 miles, which will undoubtedly be one of the most spectacular motor routes on the continent, touching three national parks in Canada and seven in the United States, will be made possible.

The construction of this road through one hundred miles of virgin country in the heart of the Canadian Rockies is an engineering feat of great moment. From the floor of the Columbia valley the road ascends 1,705 feet to the summit of Sinclair pass (altitude 4,660 feet) from which point it drops down to the Kootenay river 1,200 feet below. The second rise is the Vermilion pass and in reaching this altitude of 5,660 feet, an ascent of approximately 1,100 feet is made in the last four miles. The descent to the Bow valley is made by a series of loops or "switchbacks."

The size of the task placed before the engineers when this work was undertaken in 1919 can better be judged when it is known that forty miles of the road had to be cut through virgin timber, that eight truss, two trestle and four single-span bridges had to be constructed, the roadway carved through the huge walls of Sinclair canyon, and many other obstacles overcome.

When the Parks Branch took over the construction of the road in 1919 about 12 miles had been built by the British Columbia government from the Columbia valley. Parts of this section were widened and gone over to bring it up to the standard set for the entire stretch of 93 miles. From the Columbia valley the road continues up to the Sinclair pass through the impressive Sinclair canyon with its towering perpendicular walls of red hematite, and then drops down to the Kootenay river. It follows the Kootenay for about eighteen miles, the flat bench making construction easier. It crosses the Kootenay at what is known as Kootenay Crossing and four miles farther on it reaches the Vermilion and runs parallel to it past the mouth of the Simpson, Crossing the Vermilion about fourteen miles from Kootenay Crossing. It then continues up the opposite bank of the Vermilion to Marble canyon and the Vermilion pass, the highest altitude reached in the whole road. From there it drops down to Castle Mountain, crosses the Bow river and runs along its farther bank to Banff.

The new road opens up a hitherto unknown section of the Rockies rich in both scenery and big game. The motorist will wind in and out among the snow-peaks, through long avenues of virgin firs, or along the edge of precipices that drop sheer down for hundreds of feet.

Hurlbut Co's New Building

The Hurlbut Company, Ltd., Preston, Ont., shoe manufacturers, are completing a branch plant in St. Mary's, Ont., at a cost of about $22,000. The building is 40 x 72 ft., two storeys high and of mill construction.

Handsome Hospital in Muskoka Replaces Building Destroyed by Fire

The Muskoka Hospital For Consumptives Will be Ready, it is Expected, Early Next Summer—Some Interesting Features Involved in its Construction

The new Muskoka Hospital for Consumptives, to replace buildings destroyed by fire some months ago, will be one of the handsomest buildings erected this season. A fair idea of the extent of the hospital proper and the auxiliary buildings is shown in the accompanying photograph, although from a front view one can scarcely realize the very large floor area involved. On the left the main hospital building is shown, in the centre the service building and on the right the pump and power house. Another building, not shown in the picture, is the sewage disposal plant.

The extent of this work is also indicated in part by some figures of the quantities of materials used. For example, there were 70,000 square feet of tile arches; 75,000 square feet of tile partitions and tile backing; 240,000 exterior face brick; 20,000 interior face brick; 350,000 common and stock brick and 20,000 enamel brick. As the photograph indicates, the hospital site is solid rock and necessary excavations were made by blasting. An unexpected condition arose, however, on the site of the service building, where was apparently an old water course that had become filled up with sand and loose stones. While the ends of this building are on solid rock, it was necessary to excavate as much as 20 feet, through quicksand and running water, before bed-rock was reached in the centre of the building.

A general panoramic view of the new build

An important feature of the work was the provision for a water supply and for the disposal of the sewage where some unique problems had to be faced. In a later issue we shall deal with this phase of the construction work in more detail. The work is well along and it is hoped that everything will be ready for occupation in the early summer of 1923.

The contract is being carried out by Messrs. Jackson-Lewis Co. Ltd., general contractors, Toronto; Mr. C. S. Cobb is the architect.

A Handbook for Builders, Architects and Home-Makers

Recent scientific research by its technical departments, the United States Forest Service, fire underwriters, regional associations of lumber manufacturers and architects, has practically revolutionized the various forms of wood construction, according to the National Lumber Manufacturers Association. To mention only one phase of the progress that has been made, it is calculated that the fire hazard on a frame house of up-to-date construction has been reduced 50 per cent. Nevertheless the majority of frame houses are erected in complete ignorance of recent developments and in the same, unscientific, uneconomical and improvident way that they were generations ago.

To meet this condition of unused knowledge the Association's technical and research department, in collaboration with the Structural Service Bureau of Philadelphia, will issue a series of uniform publications which will be an orderly digest in interesting form comprehending all the available information on this subject. At present there is no one place where a builder, engineer, architect or home owner can find a summary of modern knowledge of wood construction. It is scattered through the technical periodicals, trade brochures, proceedings of societies and associations, etc. The series will be in several parts, of a number of chapters each, under the general title of "Lumber and Its Utilization" and will ultimately appear in book form. They will be carefully prepared, well printed and adequately illustrated. There will be no advertising matter or propaganda and it will be entirely presentative of facts and principles relating to the proper uses of wood in construction. The distribution will be without charge, though only upon request after the first chapter, from persons likely to make use of the data.

Three-Fourths of all Buildings Are Wood

In part, the new publications will be compilations, digests and reprints of publications that have recorded the results of current research, but there will be much new matter necessitated by the great progress recently made in the improvement of frame and ordinary construction for utility, permanence, beauty, and immunity from fire, as well as in the changing forms and species of materials. Moreover, the occasional publications have elicited many helpful criticisms and suggestions from architects, engineers, builders, educational authorities and others, of which this revision will take advantage.

Wood is Indispensable

As three-fourths of all structures are of frame construction, and wood remains the most economical structural material throughout the country, it is considered generally helpful to assemble in convenient form some of the essential knowledge and principles regarding its utilization.

The first chapter, which is devoted to an account of the purposes and technical, educational and informative work of the National Lumber Manufacturers Association, is on the press and will be mailed together with a prospectus of the complete series to architects, engineers, contractors, building officials, technical schools, colleges, libraries and trade publications.

Personal Liability for Fires

There will follow next in the series several chapters on fire prevention, the first of which will deal with the suggestion, still rather novel on this continent, of imposing personal liability for preventable fires. Copies of existing laws and ordinances on this subject are given and the hope is expressed that such legislation will tend to exert a profound influence "in correcting the defects of character which make for America so unfavorable a showing among the more prudent nations of the world." The second chapter in this series deals in detail with forms of construction that tend to stop or prevent fires in both frame and ordinary construction. Chapter III deals particularly with chimneys, flues and fireplaces. Chapter IV discusses household heating and lighting hazards and includes recommendation for the installation and protection of cooking stoves and ranges, heating apparatus, pipes, registers, steam and hot water pipes, gas and electrical appliances, etc.

ng the Muskoka Hospital for consumptives.

It is pointed out that wood is indispensable to suitable and economical housing, even though the edifice itself is of so-called non-combustible material; that it took centuries to produce the trees from which the lumber comes and that an infinite amount of labor and care goes into the manufacture of lumber, and construction, with no corresponding effort for its protection and preservation. It is only by making every board go as far and last as long as possible that the country can endure with any degree of comfort and convenience the future years of lumber scarcity. One of the major purposes of the forthcoming publications is to promote economy and conservation in the uses of wood, which are the essential concomitants of forest conservation.

Cinder Concrete Block Stands Fire Test

The Underwriters' Laboratories Endorse Blocks of One Part Cement to Six Parts of Crushed Cinders—Results are Very Favorable to the Use of Such Blocks for Building Purposes

The Underwriters Laboratories has issued a report favorable to the structural and fire-resisting qualities of the cinder concrete block made under a license of F. J. Straub, of New Kensington, Pa., the holder of U. S. patent No. 1,212,840. These blocks are made in standard 8 x 8 x 16-in. and 8 x 8 x 8-in. hollow shapes and standard 4 x 8 x 16-in. and 8 x 8 x 16-in. solid shapes of a mixture of one part portland cement and six parts crushed cinders.

The tests made were the standard fire tests conducted by the Underwriters Laboratories; that is, a straight fire exposure of 3 hr. 42 min. on a 10x11-ft. panel, a fire and hose stream test on the wall after being subjected to fire test for 1 hr., impact test of the panel, and absorption and compression tests of the individual blocks.

In the description of the test block the report reads:

The cinders which were stated to be ordinary run-of-boiler product resulting from the more or less complete burning of soft coal were a mixture of material of varying grades of fineness ranging from dust that would pass a 100-mesh sieve to pieces that would just pass a 3/8-in screen. Approximately 40 per cent by weight passed a 20-mesh screen. The presence of a considerable amount of unburned carbon was apparent on visual examination. Chemical analysis showed the presence of sulphur amounting to about 0.7 per cent of the dry weight of the cinders and of coal and coke amounting to between 18 and 19 per cent.

The 700 blocks examined in the Chicago freight house after shimpent from York, Pa., were undamaged except in minor particulars. The blocks were of a dull slate gray color and of a rough pitted texture characteristic of lean cinder concrete. The particles of cinder aggregate appeared to be completely covered by the cement. Rough handling of the dry blocks caused the separation of small particles from the surfaces, but no ordinary rough usage caused breakage. Nails were driven into the blocks without difficulty and without causing spalling, chipping, or cracking.

The report makes the following conclusions:

Fire Retardant Properties

Straub cinder concrete blocks constructed of the materials and by the methods described in this report, can be employed for the construction of exterior or interior walls, bearing or non-bearing, which when exposed to fire on either side will prevent the passage of flame through the walls and function as a barrier to the spread of fire by heat conduction for at least 2½ hours. Application of hose stream to either side of the wall during the first hour of fire exposure will not seriously impair its fire resistance.

No flame passage occurred during the fire endurance test and no through openings were found. The critical temperature of 300 deg. F. was reached on the unexposed face at 2 hr. 58 min.

The blocks may be shipped in bulk without material injury. They may be handled without difficulty and installed rapidly by any competent bricklayer using ordinary tools. Each of the two 10 x 11-ft. test walls erected in the laboratories was completed in about 2½ hours.

Durability

The blocks are capable of withstanding long-continued exposure to weather conditions without material deviation.

Specimen blocks were subjected to rather extensive series of tests involving saturation, freezing, thawing and drying. No visible deterioration was caused by any of these tests. Compression tests made on blocks subjected five times to saturation, freezing and thawing, and then three times to saturation, and drying, showed an average crushing strength of 750 lb. per square inch ond a minimum of 580 lb. per square inch of the gross sectional area. These values may be compared with the average of 815 lb. per square inch and the minimum of 650 lb. per square inch the case of blocks that had not been saturated. It is believed that these differences are not significant in view of the characteristic variations in compressive strength commonly shown by tests of concrete products.

Strength

The strength of the blocks is sufficient to warrant their use in bearing or non-bearing walls within the limitations commonly recognized as applying to materials of this character.

In general concrete blocks are considered suitable only for buildings of moderate height and with types of floor construction and of occupancy that will impose loads on the walk well within safe limits for Straub blocks.

It is believed that there are not thus far any generally accepted specifications regarding the crushing strength of cinder concrete blocks. The building code recommended by the National Board of Fire Underwriters states that the average compressive strength for concrete blocks when tested with the cells vertical, shall be not less than 800 lb. per square inch. The blocks forming the subject of this report had an average rushing strength of 815 lb. per square inch.

The effects of the impact test were purely local.

Uniformity

The blocks can be produced commercially with the degree of uniformity sufficient for the purposes for which the material is intended.

The dimensions of the blocks are determined by the dimensions of the forms in which they are cast. The density and the compressive strength are subjected to variation within rather wide limits. In the case of the blocks employed in the examinations and tests described in this report, all being the product of the same plant, examination of 12 blocks showed weights varying from 16 to 25 per cent. Compression tests showed ultimate crushing strength varying from 650 to 1,140 lb. per square inch of gross sectional area. The cinders employed in the mixing of the concrete were of rather inferior grade with 18 to 19 per cent combustible material, the presence of unburned coal or coke being evident on visual examination. Approximately 40 per cent by weight of the cinders passed a 20-mesh sieve. The results of the test made on the blocks employing this inferior aggregate and a rather small proportion of cement, were so favorable, notwithstanding the variation in some important properties, as to justify the opinion that the variations noted are within permissible limits.

Resistance to Fire of Concrete and Reinforced Concrete

The question of the resistance to fire of concrete and reinforced concrete was dealt with in a paper by Professor F. C. Lea, D.Sc., and Dr. R. E. Stradling, Ph.D., M.Sc., considered at a sitting of Section G (engineering) at the recent British Association meeting at Hull.

The paper was briefly outlined by Dr. Stradling. It described a series of experiments carried out in the Department of Civil Engineering of the University of Birmingham, with the object of investigating the effect of high temperature on Portland cement concrete, plain and reinforced. "The Surveyor" contains the following review.

In considering the effect of fire upon reinforced concrete, said the authors, the problem can be stated under two headings: (1) Is it possible to make concrete which shall retain its strength during and after exposure to the high temperatures liable to occur in a building fire? and (2) is it possible to prevent the steel from reaching such a temperature that its strength is reduced to or below that required to carry the loads occuring in the building? In a previous paper, one of the authors has already shown that mild steel at temperatures of little more than 600 deg. C. has a very low breaking stress, and that, assuming the concrete itself conducts heat sufficiently to allow the temperature of the steel to rise to more than 600 deg. C., a loaded structure is almost bound to fail. It was also shown that when the surface of concrete is exposed to certain temperatures for periods of from one to four hours the temperature of steel at given distances from the heated surface reached the dangerous temperature, and that the concrete itself was very seriously affected by exposure to temperature.

The following details are connected chiefly with the first of the two headings mentioned. Concrete essentially consists of fragments of stone held together by a network of mortar, which in itself is a finer aggregation, consisting of fine grains of sand "stuck" together by Portland cement. An examination of concrete shows that it is very porous. The mode of failure of concrete may be (1) that if the finer aggregation of mortar is caused to fail, the whole mass will be disintegrated quite independently of any effect the coarse aggregate may have; and (2) if all the stones are covered with cement, no increase in total volume can take place unless the cement itself expands. When expansion takes place, the stresses will be produced in the coating cement, and in the aggregate, unless the expansion of the cement is exactly equal to that of the aggregate. These stresses may be sufficient to cause cracking of the cement, or, when cooling takes place, may lead to separation between adjacent boundaries.

High Temperature Effects

The authors then considered briefly and mathematically the effect of high temperatures on mortars, the relative movements of cement and sand grains, the co-efficient of expansion of sand grains and of cement, the relative proportion of cement and sand, the external pressure on the spherical envelopes surrounding the sand grains, the elastic constants of cement and sand, and the effect of heat on hydrated and hardened Portland cement. Summerizing the data collected, they put forward for consideration the following as a short statement of the various factors which effect the failure of cement-sand (quartz) mortars or concretes: The effect of temperature range of 0 to 98 deg. C. on cement is that it expands at about the same rate as steel, but probably increases in strength; sand (quartz) also expands, but the relative expansion is not yet sufficient to cause failure. At 100 deg. C. cement begins to contract, and if held at this temperature the total contraction is greater than the previous expansion. Sand probably remains constant. The authors say that this point is sufficient to cause failure if the sand particles were completely covered and isolated. At 100 to 300 deg. C. cement is still contracting, the total at 300 deg. being about two and a half times as much as expansion up to 100 deg. Sand, on the other hand, is still expanding. If failure has not occurred at 100 deg. C., the mortar usually starts to fail during this range. From 300 to 491 deg. C. the cement is still contracting, and it is suggested that the $Ca(OH)_2$ probably disintegrates during this range. The sand is still expanding. Serious failure usually starts in this range. A temperature of 491 deg. C. is the apparent change point for cement, and it commences to expand. From 491 to 575 deg. C. both cement and sand are still expanding, and at 575 deg. C. there is a change of a quartz to b quartz, with linear expansion of about 0.4 per cent. This usually completes the failure, if not already completed.

Experiments have been carried out with a view to showing the reduction in strength of sand-cement mortars and concrete, three sets of mortars being used for the purpose. The results bring out very clearly the increases in strength due to the "drying out" of the cement just below 100 deg. C. The amount of this increase is probably not a definite quantity, but depends very largely on the time of exposure at the temperature.

It is shown that concretes as ordinarily used in practice to-day, containing quartz sand as a fine aggregate, lose about 20 per cent. of their strength when heated up to a temperature of 550 deg. C. Above this temperature the loss in strength is very much greater, and at about 700 deg. C. the loss is of the order of 70 to 80 per cent. It is suggested that this is probably due to the expansion of the quartz at 575 deg. C., when the ab transformation takes place. Much more fire-resistant concretes can be made by using a fine aggregate made of brick or natural rock (such as basalts or dolerites), which do not contain free quartz in any large quantities. The loss with such material is only of the order of 30 to 40 per cent. at 700 deg. C. and even higher. It is pointed out, however, that although these special concretes may carry their load during a fire, yet the after-effects may be sufficient to cause failure; these are discussed at a later stage.

As a result of the experiments carried out, said the authors, it would appear that it is possible to make a concrete which retains sufficient strength at high temperatures to carry the full loads imposed by ordinary design methods, provided the temperatures are not above 900 to 1,000 deg. C., average values to be reached in building fires. But such an assumption is only valid for the condition imposed upon the concrete during the experiments. The experimental conditions which differ from practical ones were mainly two—namely (1) concrete only was used in the experiments, and not associated with steel, as is usual in most building work now; and (2) the strength was measured within a few hours of the cooling of the specimens, which were allowed to cool in the furnace.

There are two further considerations which are of supreme importance in reinforced concrete work, considered as a fire-resisting material. These are the effect of rise of temperature on reinforced concrete, and the after-effects of fire on concrete. As to the first, with the amount of cover of concrete ordinarily allowed in design it is somewhat doubtful whether the question of heat conductivity of the concrete is of primary importance. The "spalling off" of the concrete from the steel reinforcement, will in many cases occur long before the temperature of the steel can have risen to the degree which is dangerous (contraction of the concrete begins to occur at about 100 deg. C., whereas the steel embedded in the concrete still continues to expand as the temperature rises). One of the authors has observed tests of large size slabs under fire conditions, in which spalling nearly always, if not always, preceded failure. The structure will fail due to the steel being heated to a point at which its strength is seriously affected, but this will usually happen by direct contact with the fire, and not by the heat conducted by the concrete. If a concrete which will not spall can be discovered, the conductivity will be the only menace, and not by any means such a serious one. This action is most serious on the under side of beams and the sides of columns. It might be possible to counteract this effect by increasing the cover, but without actual large scale experiments it is not possible to say. Probably a kind of burnt clay cover separated from the concrete by an air space or slag wool packed layer might be a solution, but again, full-scale experiments are required. It can now be said that the small-scale experiments have shown that much money has been wasted in large-scale experiments which were carried out in an empirical manner without any real knowledge of the fundamentals of the probelm.

After Effects of Fire

As to the after effects of fire on concrete, the importance of this cannot be over-estimated. Even though it might be possible to make a concrete by using burnt clay products or dolerites, which will stand its full load at the time of the conflagration, when the question has to be faced as to whether the building is afterwards safe, and if not, how much of it should be demolished and rebuilt, the answer would not appear to be very encouraging. In the opinion of the authors the next work in this connection should be done with full-size specimens, because, in addition to the fundamental principles upon which answer to the problem must depend, there are further factors which cannot satisfactorily be reproduced under laboratory conditions of the ordinary type. So far as the present results are concerned, the authors submit that reinforced concrete as at present carried out in practice is anything but fire-resisting, and the temperature of primary importance is a comparatively low one, probably about 400 deg. C., this being the approximate temperature of the dissociation of calcium hydrate. (The explanation of the phenomenon that concrete blocks cracked and crumbled after having been subjected to high temperatures can be found in the fact that one of the chief products of hydration of Portland cement is calcium hydrate. This dissociates into quicklime and water at about 400 deg. C., and this is accompanied by a contraction of the concrete. Concrete is porous, and the air getting in will carry moisture with it. The moisture will hydrate the quicklime again, and the product of hydration ($Ca(OH)_2$ occupies a considerably greater volume, and thus causes the concrete to crack, split, and ultimately to crumble.)

It is suggested that extremely careful and very skilful examination of reinforced concrete structures after a fire is required in order to ascertain the after-effects, and it is highly probable that the original factor of safety can never be replaced in the building structure except by complete reconstruction.

Professor Lea, dealing with the reasons for carrying out the experiments, said that the American, German and British governments had spent an enormous sum of money on large-scale experiments with a view to finding materials which could be really called fire-resisting. He was invited to join the British Fire Prevention Committee. He pointed out to the committee that they were merely getting empirical results without getting nearer to the real fundamental difficulties of the problem. Therefore, the large-scale experiments were stopped, and fundamental researches were carried out, which he hoped would continue.

Leyland Motors Limited Remove to New Premises

Leyland Motors Limited are removing from 108-110 Duchess St., Toronto, to newly built and more accommodating premises at 100 St. Patrick St., Toronto. In making this announcement it is interesting to observe the remarkable progress the Leyland truck has made in Canada. A large fleet of these trucks is owned by the government who employ them in the Service of the Canadian Air Force and the Canadian militia. The servicing of these trucks alone requires adequate organization to deal with the government's requirements. The company also count amongst their owners in Canada some of the biggest and best known merchants.

We are informed by the company that a bigger proportion of the assembling of the Leyland chassis is now done in Canada than heretofore. The labor employed in the Canadian depots is all skilled and the management only employs men who have served their time at their respective trades. Branches have recently been opened at Montreal and Vancouver.

It is interesting to observe that the price of Leyland trucks is competitive with the front rank American machines. In many quarters it has been thought that the Leyland is higher in price than other good machines, but this impression is erroneous.

The Leyland company were the first, if not the only firm, to foresee the advisability of controlling all the surplus war equipment of their manufacture. They therefore purchased back from the government more than 2,000 W. D. subsidy type Leyland chassis and passed them through a specially equipped factory and reconditioned them to a point of newness which enabled the company to sell them to the public with the same guarantee as that given with brand new machines.

Serious Ravages of the Marine Borer

J. A. Codere of the Forest Products Labortories of Canada Describes How Structures are Destroyed by These Organisms and How They May be Protected

J. A. Codere, specialist in wood preservation for the Forest Products Laboratories of Canada, Montreal, read an interesting paper on October 18, before a representative gathering of the St. John, N. B., branch of the Engineering Institute of Canada. The paper was most instructive and lantern slides illustrated the ravages of the marine borer among buildings, railroad trestles and pilings in and adjacent to the salt water.

The speaker first described the body of the borer, showing specimens of the species and the manner in which the pest accomplishes its deadly work. The mouth is cylindrical in shape with a pallet inside. Parallel ridges of sharp shell, strengthened by succeeding layers of shell cover the mouth, which is opened and closed by muscles while the boring is in progress.

A slide was shown, portraying the mouth, gills and dorsal cavity leading to the discharging syphon. As the borer eats its way into the wood the chips pass through the body, but do not constitute the food of the animal. It bores for a home, and while boring a continuous stream of sea water or moist extracts pass through its digestive system.

The borer enters the timber in a horizontal manner and when inside starts to bore a vertical direction. One specimen on entering the wood leaves only a pinhole in its wake and the deadly work would not be noticeable from the outside.

Long experience has shown that in the preservation of wharf piling and railroad trestles, creosote has proven its value against the inroads of marine borers. Some varieties of timber do not take easily to the absorption of creosote, whereas birch, pine and poplar not only freely take in the preservative but are ranked among the best water resisting timber used in piling. Spruce and hemlock do not readily absorb the creosote. Timbers to be used in the water front should be seasoned and piled on skids ten inches from the ground and separated by a strip two inches wide to permit of a passage of air.

Creosote Treatment

Treating of timber with the solution is carried on by two methods namely the open tank method and the compressed air system of forcing the creosote into the wood. Slides were thrown on the screen showing both the open tanks of the hot and cold fluid and cylinders into which the piles were placed subject to a pressure of boiling hot creosote 200 lbs. to the square inch. In treating the piles it is equally necessary to treat both the upper and the lower portion so that the upper end will not be corroded with fungus. The latter is a plant which sends roots into the wood eating away the substance of the timber.

The C. P. R. have a large plant at Sudbury and have treated during the past year over one million and a half of hemlock and pine railroad ties. The ties are loaded onto steel cars and run into cylinders. Slides showing small commercial plants treating boards and small lumber were shown. After the creosote has been injected the timber is cooled for five or six hours and to determine the depth to which the solution has permeated an auger is used. Care must be used when handling the treated timber with peavies and hooks that no holes are exposed to the borer which is quick to see an opportunity. Brackets and fastenings under water should be avoided as they tend to afford an opening through the creosote zone.

The maple and sap wood cedar shingles are not affected to any extent by creosote. In the case of the maple when subjected to the pressure system of treating, the penetration of the surface is hardly discernible and layers of creosote are formed on the inside. A cedar shingle under 250 lbs. pressure came out perfectly dry. There is no solution to the fact that some timbers will take the solution readily and others will not.

The paper was particularly interesting and instructive to those of the Engineering Institute who are connected with the Public Works and harbor and ferry departments of the city.

American Good Roads Congress

An organization, insuring conditions that will be as nearly one hundred per cent perfect as possible, is being formed by the American Road Builders' Association to handle the arrangement for the Thirteenth American Good Roads Congress and Fourteenth National Good Roads Show, to be held in Chicago on January 15 to 19, 1923. While most of the important features of last year's show will be retained, many new and novel features will be added. The program for the congress has been revolutionized and instead of holding the sessions at the Chicago Coliseum where the show will be housed, they will be held at the Congress Hotel. It is believed that this will insure a better attendance at each session while the show will continue without interruption. The arrangement, too, will eliminate all the noises heretofore so disturbing to the speakers and convention delegates.

Almost immediately following the last congress and show the American Road Builders' Association revised its Constitution and by-laws to some extent and elected new officers and directors. Meanwhile exhibitors at the last good road show perfected the Highway Industries Exhibitors' Association, with headquarters in Chicago, for better co-operation in making the next show a greater success than any held heretofore. The executive committee of the A.R.B.A. created a special convention and show committee to have supervision of all arrangements for both of next year's events. The general committee has created a number of sub-committees on program, reception and hotel, entertainment, registration, exhibits, banquet, local press, transportation and general publicity. Each sub-committee will be composed of active members of the road builders' organization who have had experience with past expositions and conventions.

The exhibits committee has employed a professional director of exhibits and the publicity committee has employed an experienced publicity man as director of publicity.

According to chairman Upham of the general arrangements committee the chief difficulty will be in providing space for all the exhibits, though arrangements will be made for all the additional space that it is possible to obtain. "The program for the congress," said Mr. Upham, "as it is now being worked out, will be entirely different from any that we have had heretofore. Instead of avoiding controversial subjects as in the past, the program will consist of controversial subjects of vital interest to the whole road-building industry. This will heighten interest in the sessions and will provoke interesting and informative oral discussions.

"The Highway Industries Exhibitors' Association," continued Mr. Upham, "is working in close touch with those in active charge of the arrangements. We expect to conduct a publicity campaign with more far-reaching effect and greater compelling force than any heretofore and I believe the attendance will break all records."

The general offices of the American Road Builders' Association have been moved from 11 Waverly Place, New York, to 37 West Thirty-ninth St., New York, and while the work of arranging for the congress and show, for the most part, will be carried on there, headquarters will be opened in Chicago at an early date.

How to Slake Lime

The American Society for Testing Materials has drawn up a set of directions for slaking lime. It sometimes happens that a new man on the job will ruin a good batch of lime by burning or drowning it. Such conditions should not occur, and if he could be given some simple instructions as to a practical way of determining how much water to use, and how to use it, he could follow them and make the best use of the materials.

The following general directions, prepared by the committee, apply to lime in general, and will prove invaluable to the builder. They may need to be varied to meet special conditions, and actual experience is a better guide than fixed rules.

"(a) Introduction.—Different kinds of lime vary considerably in the way in which they behave with water. A little supervision over the operation of slaking will amply pay for itself by insuring the production of the greatest possible quantity, and the best possible quality, of putty. To find out how to slake a new lot of lime, it is safest to try a little of it and see how it works. Since different lots of the same brand of lime vary somewhat, and since the weather conditions at the time have a decided influence, it is wise to try a sample from each lot used, whether you are familiar with the brand or not.

"(b) Classification of limes.—In a bucket put two or three lumps of lime about the size of your fist, or, in the case of granular lime, an equivalent amount. Add enough water to just barely cover the lime, and note how long it takes for slaking to begin. Slaking has begun when pieces split off from the lumps or when the lumps crumble. For the test, use water of the same temperature that will be used on the job.

"If slaking begins in less than five minutes, the lime is quick-slaking; from five to thirty minutes, medium-slaking; over thirty minutes, slow-slaking.

Directions for Slaking

"(c) For quick-slaking lime, always add the lime to the water, not the water to the lime. Have enough water at first to cover all the lime completely. Have a plentiful supply of water available for immediate use—a hose throwing a good stream, if possible. Watch the lime constantly. At the slightest appearance of escaping steam, hoe thoroughly and quickly, and add enough water to stop it. Do not be afraid of using too much water with this kind of lime.

"For medium-slaking lime, add the water to the lime. Add enough water so that the lime is about half-submerged. Hoe occasionally if steam starts to escape. Add a little water now and then if necessary to prevent the putty from becoming dry and crumbly. Be careful not to add any more water than required, and not too much at a time.

"For slow-slaking lime, add enough water to the lime to moisten it thoroughly. Let it alone until the reaction has started. Cautiously add more water a little at a time, taking care that the mass is not cooled by the fresh water. Do not hoe until the slaking is practically complete. If the weather is very cold, it is preferable to use hot water, but if this is not available, the mortar box may be covered in some way to keep the heat in."

New Bulletins

The Canadian Ingersoll-Rand Company, Limited, has issued two new bulletins, Nos. K-701 and K-702, entitled "'Circo' Steam or Air Hoists" and "'Circo' Electric Hoists" respectively. The bulletins are well illustrated and describe in detail the construction and arrangement of the various machines, giving specifications covering models for use under ordinary conditions.

Douglas Fir

On account of its strength and the size in which it can be obtained Douglas fir of British Columbia is considered as Canada's finest wood for structural purposes although it has many other uses. The tree reaches heights exceeding 250 feet and diameters above seven or eight feet although its size is much below this on an average in the interior part of British Columbia. It is an important timber for structural purposes, for the production of lumber, railway ties, piles, mine timbers, wood block paving and many other purposes.

Water Works and Water Supply

A Committee Report Presented to the American Society for Municipal Improvements

Economic Conditions

This committee report records a number of points of interest in this important field of municipal improvements to facilitate discussions at the convention.

The past year has been a notable one of the reconstruction period following the great war as regards the lower cost of money, particularly the rates on bond issues for municipal inprovements, and the substantial stabilization of labor and materials, comparatively speaking. Construction materials are now 60 to 70 per cent. above pre-war normal. The labor market varies widely in different sections of the country, both as to quantity and price. In some localities labor is available at almost pre-war prices while in other localities it is scarce and at nearly double pre-war normal.

Water Works Improvement

Many water-works improvements have moved forward actively during recent months and there is little or no indication that sizable projects are being held up in anticipation of substantially lower prices than now prevailing. On the contrary, there are many who feel that construction costs are likely to increase rather than decrease.

Water Supply Improvements

Numerous water supply improvements, deferred in many instances as a result of the war, are now under construction. Filters and reservoirs are being extended at many large cities. The cities on the Great Lakes as a group have been particularly active in the installation of filtration plants.

Water Supply Sources

Some of the larger communities of the country have given much consideration to mapping out a future program as to additional sources of municipal water supply.

Water Purification

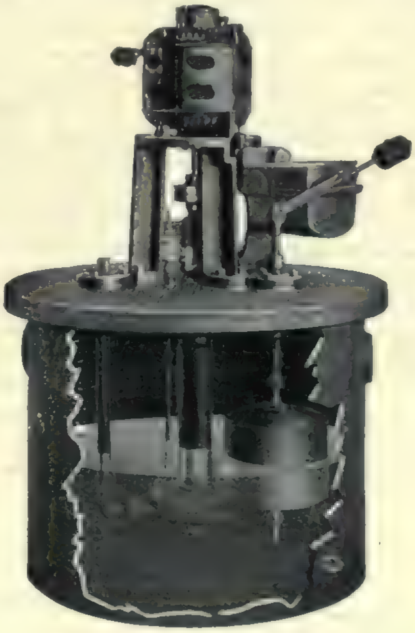
So far as known to the committee, there have been no novel or unusual features developed in water works practice within the past year. Technical men have considered and discussed the present status of hydrogen-ion concentration in the control of water-purification plants. So far as now apparent, it is not likely that plant designs will be substantially changed as a result of this new method of studying the most suitable condition in which a water may be prepared for passage through rapid or mechanical filters. Engineers and plant managers await word from the laboratory men as to the practical significance of this new way of controlling filter operation. Extensive reports covering recent scientific investigations in water purification will be found in the current proceedings of the American Water Works Association and the American Chemical Society.

Official Standards of Quality

Official government standards for the quality of drinking water, so far as water used by the railroads and steamboats is concerned, have been measured since 1914 by the so-called Treasury Department standard, formulated by a commission appointed by the United States Public Health Service. Last May a commission was appointed to consider what, if any, modification of these official standards are needed both as to laboratory methods and interpretation of the same.

New Vertical Sump Pump

The old saying, "necessity is the mother of invention". is exemplified by the development of the vertical sump pump. A great many modern factories and other buildings find a part of their basement lower than the sewer, with the result that it is necessary to elevate the water by artificial means, the ordinary method being by a vertical centrifugal pump. One of the latest designs, as built by the Smart-Turner Machine Co., Limited, Hamilton, Ont., is shown in the accompanying illustration. The equipment is very simple, consisting of a centrifugal pump and vertical motor, with float and float switch so arranged that when the water in the sump rises to a pre-determined point, the float trips the switch, starting the motor. When the sump is pumped down to the proper level, the weight of the float disconnects the switch, and stops the motor. The equipment as built by the Smart-Turner Machine Co. is self contained, everything being attached to the floor plate, the pump stuffing box and the oiling of the pump all being above the plate. The coupling between the motor and the pump shaft is of a flexible type, so designed that no weight can come on the motor. The pedestal supporting the motor contains a thrust bearing, which takes the weight of the vertical shaft and impeller.


The Smart Turner centrifugal pump

For polyphase current, in addition to the float switch, an automatic starter with overload protection is provided, so that in the event of one of the fuses being blown, the equipment cannot be started. In this way, possible burnout of the motor is prevented. With single phase current this protection is not necessary. The pumps are built in sizes from 10 gallons per minute up to 2,000 gallons.

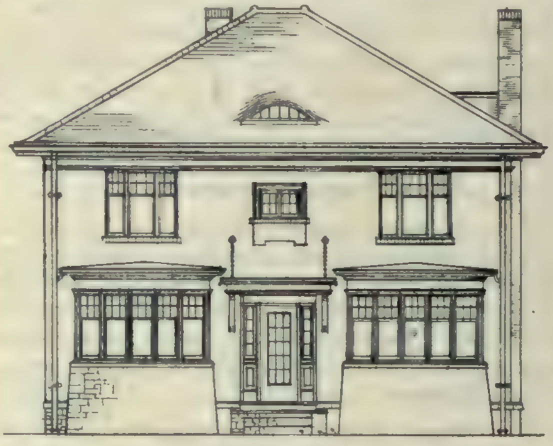
The Contract Record's

Weekly House Suggestion No. 43

This handsome residence, of the ever-popular square-plan type, was designed by the Toronto architectural firm of N. A. Armstrong Co. Ltd. and built in the St. Lawrence Park district of Toronto this summer. The exterior construction is stucco on tile, with stone trim and brick sills and chimney. The main entrance is the outstanding feature of the exterior appearance; it is equipped with a suspended canopy and handsome door of oak veneer and plate glass, with three stone steps up to it. The roofing is of stained wooden shingles.

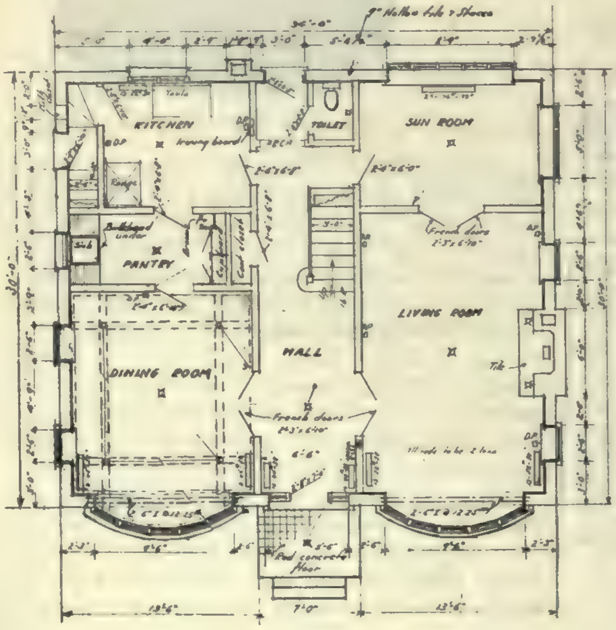
There is a wide hallway running the full length of the house and dividing it into two equal sections, with living room and sunroom on the right and dining room, pantry and kitchen on the left. The large living room has a beautiful, wide bay window at the front and a handsome brick mantel. faced with 6" x 6" tiles, in the side wall, as seen on reproduced plan. There is also a 6" x 6" half beam, built-up cornice around the walls in this room, at the ceiling. The sunroom, to the rear, is entered from the living room through double French doors. There is also a doorway from the sunroom to the hall. There is a toilet in the hall, immediately inside the rear entrance. The dining room also has a large bay window at the front and is finished with a beam ceiling. The kitchen and pantry arrangement is ideal in this layout, being convenient to dining room and rear entrance and at the same time well isolated from the living quarters. The kitchen is equipped with built-in ironing board, and the pantry has a built-in broom closet and the usual cupboard space. The dining room, living room and hall are trimmed in gunwood, finished walnut, while the trim in the kitchen, pantry and sunroom is pine, with an ivory enamel finish. The flooring throughout the ground floor is quarter-cut oak.

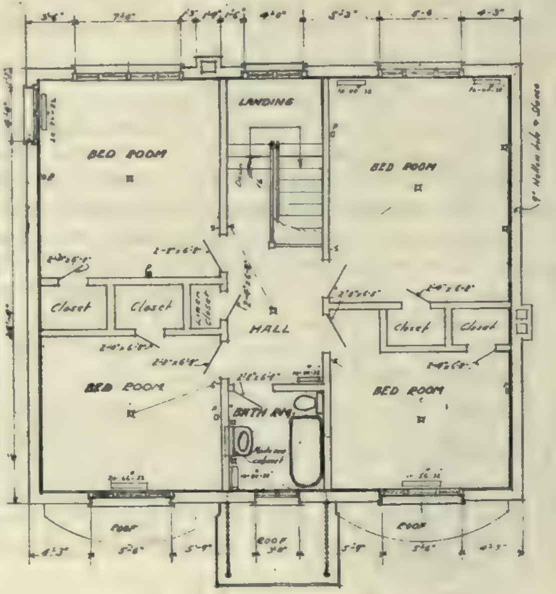
The layout of the bedroom floor is simple and convenient, the four rooms having direct entrance on the square hall, with the bathroom located in the hall at the front. The flooring in the hall is of quarter-cut oak and of plain oak in the bedrooms, and the bathroom trim is in white enamel.



The basement is divided into laundry, boiler room, fruit cellar, coal bin—the latter equipped with a sliding door—and a large space on the right which may be utilized as a billiard room.

This house may be built for $10,000.





Mainly Constructional

East and West—From Coast to Coast

During October, construction contracts awarded in Canada, according to MacLean Building Reports, Limited, amounted to $24,270,300, compared with $29,313,500 in September. Residential building accounted for 36.2 per cent. of the October total, and amounted to $8,794,600. Business building amounted to $6,065,000, or 25 per cent.; industrial building, $3,221,500, or 13.3 per cent.; public works and utilities, $6,189,200, or 25.5 per cent. The value of contemplated new work reported during October was $15,938,300.

Nearly half a million dollars have been spent at the town of Kingsville, Ont., this summer, making improvements to the town. The cost of paving the streets amounted to $150,000; the new memorial hall cost $40,000; park improvements, $1,500; four new business blocks, $200,000; dwellings, $120,000; filter plant, $30,000; estensions to water mains, $30,000; high school, $55,000, and public school, $52,000.

The official opening of the new War Memorial Children's Hospital, at London, Ont., took place a few days ago. The building is a handsome structure of rug brick, attractively trimmed with stone. It was designed by the Toronto architectural firm of Watt & Blackwell and cost in the neighborhood of $250,000 to erect.

The Ontario Department of Public Works will be moved from its present location at the Parliament Buildings, Toronto, to the Veterinary College building at the corner of University Ave. and Dundas St. The headquarters of the Ontario Veterinary College has been transferred to Guelph and, as their building is the property of the province, the Department of Public Works are taking advantage of the opportunity to acquire these more commodious quarters. The accommodation at the Parliament Buildings is scarce owing to the rapid growth of this department. It is now planned to re-arrange the various other departments at the Parliament Buildings.

A recent statement is to the effect that the Asbestos Corporation of Canada will spend $500,000 upon milling additions at their plant at Asbestos, P. Q.

Toronto has already this year established a new record for building permits issued in any one year in the city's history. The total value of permits issued up to a few days ago was just a few thousand short of $30,000,000, and with two months still left in the year, this figure should be considerably augmented. The record value of permits issued in any one year in the city's history formerly stood at $27,401,000 in 1912.

Work on the Welland ship canal, the largest engineering work under progress at the present time in the world, is going ahead steadily. Lock No. 1 at Port Weller, on Lake Ontario, is 90 per cent completed. The cement work is 97 per cent. finished on this lock. Comparatively little remains to be done on this section of the work, and another season's work should see it completed. Lock No. 2 is almost as far advanced as No. 1, with most of the concrete work finished. The pits for Locks No. 3 and 4 are partially excavated, and the excavating for Locks 5, 6, and 7 is almost finished, and a portion of the concrete floors has been laid.

Sewer, water works extensions and roads by-laws, for $100,000 each, will be submitted to the electorate of Vancouver at the next municipal election which will be held in December.

A provincial loan of $950,000 has been granted the town of St. Lambert, P. Q., for civic improvements which will be carried out next spring.

The report of Hon. J. L. Perron, Quebec Minister of Highways, tabled recently, states that 75 per cent of the roads under construction this season will have been completed before winter. The total mileage of regional and municipal roads now controlled by the department is 4,354.

The city council at Windsor, Ont., and the local water commission have agreed to submit a proposal for a separate filtration plant for the city to the ratepayers at the approaching municipal elections. The details of the scheme will be worked out at another meeting.

A recent announcement states that the entire 70 miles of the Cochrane-Newport extension of the Temiskaming & Northern Ontario Railway is now under active construction, 45 miles having been graded and 20 miles of rails having been laid. Work will proceed during the winter months, but will be confined chiefly to clearing. It is anticipated that a start will be made on the final 90-mile extension on this line to James Bay within the next two years.

Mr. John Grieve, general manager of sales for the Dominion Paint Works, Ltd., addressed the Montreal Branch of the Engineering Institute of Canada at a recent meeting, on the subject "Paint and Its Proper Use for the Protection of Structural Steel."

Personal

Mr. W. G. Van Egmond, well-known architect of Regina, Sask., has been appointed president of the Saskatchewan Association of Architects.

Mr. George W. Otterson resigned from the staff of the Canadian Municipal Equipment Corporation, Ltd., of Toronto, recently, where he was connected in the capacity of mechanical engineer, to take over the presidency of the Otterson Equipment Company, of Newark, N. J. He is succeeded by Mr. Johannes Ruckstinat, formerly with the Bawden Machine Company, Ltd., Toronto. The latter was at one time connected with the Thomas A. Edison Laboratories, engaged in research work on electric storage batteries.

Mr. M. E. Brian, city engineer of Windsor, Ont., has been recommended by the Financial Committee of the City Council for a $500 bonus, in recognition of his highly satisfactory administration of the local Public Works Department.

G. W. F. Price, city architect of Toronto, has been granted two months leave of absence, on account of ill health. Mr. J. J. Woolnough, of the department, will take Mr. Price's place during his absence.

Obituary

Mr. Richard West, Toronto contractor, died recently in that city. Deceased was born in Ireland, but had resided in Toronto for the past 65 years. He was at one time a member of the contracting firm of Godson & West, but retired from business several years ago.

Hydro Plant at Paugan Falls

The contemplated hydro-electric development at Paugan Falls, P. Q., will have an ultimate capacity of about 150,000 h.p., according to a report from G. Gordon Gale, vice-president and general manager of the Hull Electric Co., who also states that until certain surveys have been completed, it cannot be stated what this undertaking will cost, nor when construction will commence.

CONSTRUCTIONAL ACTIVITY

Period of Nov. 1 to Nov. 7, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Brantford, Ont.
City Council contemplate construction of sidewalks and sewers on several streets.

Hamilton, Ont.
S. H. Kent, City Clerk, will receive tenders until Nov. 15th for manufacture and delivery of semi-circular sewer invert lining, 1160′, 33″ diameter, 1300′, 30″ diameter. E. R. Gray, Engr.

Nepean Twp., Ont.
Twp. Council plan construction of drainage system at cost of $135,000. Patterson & Byrne, Engrs., 72½ Sparks St., Ottawa.

Port Dover, Ont.
Town Council plan construction of pavement on Main St.

Quebec, Que.
Prov. Gov't., Dep't. of Roads, contemplate roadwork on following highways: Beauce Junction-Sherbrooke; Rimouski-Matapedia; Laprairie-Valleyfield; Richmond-Yamaska; Laprairie-Lacolle; Levis-St. Lambert; Levis-Sherbrooke; Beauceville-Sherbrooke; Quebec-St. Simeon; Levis-Rimouski; Drummondville-Annaville; Grande Baie-St. Bruno; St. Bruno Roberval-St. Bruno; Victoriaville-Woburn; Rawdon-L'Assomption.

CONTRACTS AWARDED

Bonnington Falls, B. C.
J. L. Purdy, Bonnington Falls, has general contract for branch highway costing $21,000 for Prov. Gov't., Dep't. Pub. Works.

Hamilton, Ont.
General contract for construction of storm and sanitary sewer costing $84,994 on Kenilworth Ave. for City is awarded to Central Foundation Co. Ltd., 14 Wellington St. E. R. Gray, Engr.

Hull, Que.
Contract at $35,000 for paving Dupont and Jean Baptiste Sts. for City is awarded to Standard Paving Ltd., Central Chambers, Ottawa. Theo. Lanctot, Engr.

Three Rivers, Que.
General contract for construction of concrete road costing $8,000 for City is awarded to Ed. Bourassa, 95 Notre Dame St. Chs. Gelinas, Engr.

York Twp., Ont.
Grading contract No. 778 at $25,000 for Prov. Gov't. is awarded to Dufferin Construction Co., Brass Bldg., Toronto.

Railroads, Bridges and Wharves

Kelly, Ont.
Plans are being prepared for station for G. T. Ry.

Ste. Genevieve de Batiscan, Que.
Prov. Gov't., Dep't. Pub. Works, will rebuild highway bridge which was destroyed by a recent fire.

CONTRACTS AWARDED

Aultsville, Ont.
General contract for reconstruction of wharf for Dom. Gov't. is awarded to Fallon Bros., Cornwall.

Berthierville, Que.
General contract at $7,350 for improvements to wharf for Dom. Gov't. is awarded to H. Gravel, St. Lambert, Que.

Kincardine, Ont.
Contract at $21,676 for repairs to piers for Dom. Gov't. is awarded to Keys Bros., Kincardine.

York Mills, Ont.
Sullivan & Fried, 81 Victoria St., Toronto, have general contract for construction of car barn, freight shed, office and station costing $50,000 for Ontario Hydro Electric Cmsn.

Public Buildings, Churches and Schools

Lansing, Ont.
Ellis, Ellis & Richardson, architects, Manning Chambers, Toronto, have plans and will receive tenders until Nov. 14th for erection of school to cost $50,000 for S. S. No. 4, North York Twp.

Niagara Falls, Ont.
C. M. Borter, architect, 102 Main St., is preparing plans for addition to school to cost $80,000 for School Bd.

Owen Sound, Ont.
H. H. Wright, Chrm. School Bd., will receive tenders until Nov. 21st for erection of school costing $185,000 for City. Plans with Watt & Blackwell, architects, Bank of Toronto Bldg., London, and Forster & Clark, associate architects, 887-2nd Ave. E., Owen Sound.

Port Credit, Ont.
Ellis, Ellis & Richardson, architects, Manning Chambers, Toronto, have plans and will receive tenders until Nov. 13th for erection of school to cost $33,000 for S.S. No. 23, Toronto Twp.

Stratford, Ont.
Erection of technical school is contemplated by School Bd. J. M. Riddell, secy., Downie St.

Westmount, Que.
Erection of gymnasium at cost of $35,000 on Sherbrooke W. is contemplated by Temple Emmanuel Congregation.

CONTRACTS AWARDED

Brantford, Ont.
General contract for alterations and additions to Mohawk Institute costing $86,000 for Dom. Gov't., is awarded to Schultz Bros. & Co. Ltd., Albion St.

Brooklands, Man.
General contract at $26,218 for addition to school for Brooklands S. D. No. 1440, is awarded to Wyatt-Ireland Ltd., Winnipeg. Plumbing, heating and ventilating contracts are placed with C. D. Kirk Co. Ltd., Winnipeg. A. Melville, architect, Bank of Nova Scotia Bldg., Winnipeg.

Craigmyle, Alta.
J. Murdock, Craigmyle, has general contract for erection of school for Surprise S. D. No. 2142.

Kingston, Ont.
General contract for erection of library for Queens University is awarded to Anglin-Norcross Ltd., 65 Victoria St., Montreal. Shepard & Calvin, architects, Excelsior Life Bldg., Toronto.

Merritton, Ont.
Jos. Lee, Welland St., Thorold, has general contract for erection of hall and residence costing $13,000 for Mountain Mission. Masonry contract is placed with Broom & Chamberlain, 35 Louisa St., St. Catharines. T. H. Wiley, architect, 128 St. Paul St., St. Catharines.

Mimico, Ont.
Roofing contract for church costing $30,000 for Methodist Church Congregation is awarded to A. W. Carmichael Ltd., 918 Palmerston Ave. Horwood & White, architects, Ryrie Bldg., Toronto.

Montreal, Que.
Additional contracts for school and residence costing $154,000 for Catholic School Cmsn., Central District, are: Roofing, M. Chouinard, 751 Adam St.; painting and glazing, Birch & Drouin, 195 St. Catherine E.; blackboards, marble and tile, E. Lepage, 990 Parthenais St.; fire escapes, Gravel & Drouin Ltd., 255a Craig E. I. Vautrin, architect, 30 St. James St.

Additional contracts for school costing $156,000 for Catholic School Cmsn., East District, are: Roofing, L. P. Ducharme & Co., 2056 St. James St.; plumbing, De Giorgio Ltd., 12 Lagauchetiere E.; painting and glazing, B. Navert, 1229 St. Denis St.; blackboards, marble and tile, E. Lepage, 990 Parthenais St.; sash and doors, F. Tremblay & Co., 400 William St.; fire escapes, Gravel & Drouin Ltd., 255a Craig E. Gascon & Parent, architects, 502 St. Catherine E.

Steel contract for police courts costing $3,000,000 for Prov. Gov't. is awarded to Dominion Bridge Co. Ltd., Dominion Station, Lachine. E. Cormier, 511 St. Catherine W., L. A. Amos, 70 Crescent St., and Chas. J. Saxe, 264 Dorchester St. W., architects.

Contract for steel lockers for school costing $200,000 for Catholic School Cmsn., North District, is awarded to J. A. Elder, 300 Notre Dame W. E. Cormier, architect, 511 St. Catherine W.

Marble and tile contracts for class room costing $35,000 for Ecole Tech-

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U. S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, November 15, 1922 No. 46

Are Building Costs Coming Down?

A prominent Toronto weekly has been treating the matter of building costs editorially and vehemently affirming that construction costs are due for a drop, claiming that they have been unduly inflated to such a degree as to seriously curtail the amount of building that might have been carried out had costs been lower. For example, in an issue of two or three weeks ago this editor was thoroughly convinced that the building boom that has been evident all summer was due for a sudden and calamitous stop, that building costs were to decline rapidly and that houses were to be a drug on the market at prices much lower than those now prevailing. What connection with or knowledge of the building industry the magazine possesses is not evident on the surface; and by what process of reasoning it arrived at these conclusions is beyond our comprehension. Sane and careful investigation of the facts and factors affecting construction at the present time only leads to the opinion that costs cannot fall from the present level. That the public has accepted this view is apparent from the way in which building volume has this year established a record. Any attempt, misleading as it certainly would be, to predict lower costs, would certainly be followed by a slowing up in building—a situation that would only tend to augment the unfilled construction requirements and therefore, increase costs beyond their present level. As a matter of fact, building costs compare very favorably with costs of other commodities and we know that contractors are making every attempt to give their efforts at the very lowest price that is possible under present circumstances. An opinion to the contrary is only based on a misunderstanding or lack of knowledge of fundamental economic principles.

In the opinion of many authorities, not only will construction costs not decrease but on the other hand, they will continue to increase to a higher level than at present. Such is the opinion of the Associated General Contractors of America, for example, according to whom not only has the cost of building been going up for several months, but so has the cost of materials. Wages in the building trades have more recently begun to increase also. The general average of wholesale prices has been increasing since the first of the year.

* * *

"The behavior of all these prices in increasing during a time of recovery from business depression," state the contractors, "is entirely normal. It is a phenomenon which always occurs during like periods. We believe it is a very strong indication that prices in general have been stabilized for the present on a new price level in the neighborhood of seventy per cent higher than that which prevailed in 1913. This means that prices will continue to go up until the present period of prosperity is fully established and will not go down again until the beginning of the next business depression. The next depression will probably be only a moderate one—such as we were familiar with before the War—and will be accompanied by only moderate decreases in prices.

"Instead of expecting that building costs will be materially lower eighteen months from now, we anticipate that they will continue to increase during the greater part of that period, and that they will be at that time, perhaps, at about the beginning of a decrease but at a point higher than the present. We believe, further, that the decrease which may be expected to begin at about that time will not go to a point very much below the figures reached during the past winter."

* * *

In explaining their reasons for their opinions, the contractors say that the costs of building materials are going up partly because they are partaking of the general tendency of prices to rise during this part of the economic cycle, and partly because we are experiencing a building boom of unprecedented volume. Wages of building labor are increasing partly because of the shortage brought about by this same building boom and partly because of a recovery in other lines of industrial activity, which is already beginning to produce labor shortages.

"It may be that some believe the present building boom has about run its course, and that, for that reason, building activity will soon diminish and building costs go down. We believe the outlook to be far otherwise. The boom shows no signs of abating. For six successive months the figures for contracts let have been record-breaking. The slight recession of August is less than the usual recession. As a result of very painstaking investigations it has been estimated that the deficit in building, the country over, is so great that building could continue for ten successive years, beginning with this year, at 25 per cent above normal before catching up with that deficit. We do not predict any such sustained activity, but we do point to the figures as proof that there is no possi-

No. 89

Canada's Engineers—E. G. Deville

The Engineering Institute of Canada paid splendid tribute to the outstanding ability and lifelong service of one of the most prominent engineers in Canada, when, on October 31, it elected to life membership Dr. Edouard G. Deville, L. L. D., D. T. S., Director of Surveys in the Department of the Interior, Ottawa. The conferring of that honor was made the occasion of a luncheon which was tendered to Dr. Deville as a mark of esteem by the members of the Ottawa Branch of the Engineering Institute of Canada and a number of prominent engineers were present to do honor to a man who for 47 years has been an official of the Canadian Government and who has occupied his present position since 1885, some 37 years. It is not generally known that Dr. Deville was born in France and began his brilliant career as an officer of the French Navy, when he was in charge of extensive hydrographic surveys in the South Sea Island, Peru and other countries. He resigned from the Navy in 1874 to come to Canada and after considerable work in connection with survey work for the Quebec government, he joined the surveys staff of the Dominion government. On the resignation of Lindsay Russell as surveyor general, Dr. Deville succeeded him, holding this position until this year when he was raised to the office of Director General of Surveys and was placed in charge of all survey work of the Department of the Interior.

By study and research, Dr. Deville has gained an enviable reputation as an international authority on matters pertaining to his particular vocation and on several occasions has creditably represented Canada at international scientific gatherings, where he has always created an impression through his wide knowledge of surveying and engineering matters. It is undoubtedly true that to Dr. Deville is due that perfect system of land surveying of which this country can boast. It has indeed been his genius that has perfected and applied efficient methods to the mapping out of this northern half of the American continent. Dr. Deville is author of several valuable books dealing with surveying matters and he has also been a regular contributor of papers on various matters of scientific interest to the Royal Society of Canada. In 1905 the University of Toronto conferred on him the degree of Doctor of Laws and in 1915 the King appointed him a Companion of the Imperial Service Order. Dr. Deville has also done very much work along physical research lines in connections other than those concerned with his departmental duties. For example, he has been responsible for developing special lenses for scientific apparatus for the Eastman Kodak Company of Rochester, N. Y. and it is also a matter of interest that the cameras taken on the Mount Everist expedition were built on models invented by Dr. Deville.

Dr. E. G. Deville
(International Press photo)

bility of the present building boom coming to an end within the next few months, because of having completely filled the demand for new construction."

Construction Activity Strongly Maintained

During October, construction contracts awarded in Canada, according to MacLean Building Reports, Limited, amounted to $24,270,300, compared with $29,313,500 in September. Residential building accounted for 36.2% of the October total and amounted to $8,794,600. Business building amounted to $6,065,000, or 25%; industrial building $3,221,500, or 13.3%; public works and utilities $6,189,200, or 25.5%. The value of contemplated new work reported during October was $15,938,300. During September, the wholesale price index, of 48 building materials declined a point, being 82% above 1913, compared with a peak of 183.8% reached in May, 1920. Prices are 35.8% from the high.

During the season now drawing to a close, the heavy demand for materials and labor and the greater volume of business in all industries, has tended to create a firming of prices. In regard to types of new construction, there seems to be a trend away from the speculative and residential, with an increase in the volume of public and institutional work. It appears strongly that we are now at the beginning of the predicted second wave of building activity, to be composed of large and higher class units, such as public and institutional buildings. This autumn finds architects generally busier than for many years, and this gives ground for optimism. The outlook for industrial and commercial building is good. Excepting for some artificial or incidental restriction, it would seem that building activity should continue strongly. For many years there have not been available such large sums of mortgage money, and the confidence of the investing public seems to have been strongly asserted.

Trade Incorporation

La Compagnie d'Aqueduc de Lac Bouchette, Limitee, with head office at Lac Bouchette, P. Q., capital $20,000, to own and operate a water works plant at this point.

Estimating the Cost of Stone Setting

Figures and Data to Enable Contractors to Figure on Work Involving Cut Stone, Architectural Terra Cotta, Artificial Stone or Cement Blocks—Handling, Setting and Cleaning Costs

By CHAS. F. DINGMAN, M.Am. Soc. C.E.

(Copyright 1922 by Chas F. Dingman)

When we come to estimate the cost of setting cut-stone, including architectural terra-cotta, artificial stone, cement blocks, and all kinds of natural stone, we can go into a great deal of refinement and can, if we collect accurate data, learn to prepare estimates that should vary but little from the actual cost of doing the work.

In estimating the cost of setting all sorts of ornamental work, as well as natural stone ashlar, the cubic-foot seems to be the most satisfactory unit of calculation and I also prefer the cubic-foot as a basis in figuring architectural terra-cotta, though others figure it by the square-foot of surface area and some by the ton. The individual block seems to be the most satisfactory unit for figuring cement block work

Cement Block Work

The most common size of block used is 8" thick, 16" long, and 8" high, weighing from 50 to 60 lbs. depending upon the percentage of core-voids and the density of the concrete used. Blocks 12" long and 8" high, as well as other shapes, are also used but not as extensively as the 16" x 8". In addition to the "stretcher' blocks, it is necessary to have corner and jamb-blocks, as well as lintels. On the better jobs, short stretchers will be provided to make closures.

Various methods of organizing are used for cement block work, but the most satisfactory method seems to be to have a helper for each mason, to assist in lifting the blocks onto the wall, and one man to mix mortar and serve it to each two masons.

Additional men will be required to bring the blocks from the piles and distribute them along the wall, since the helper cannot be expected to handle them for a greater distance than ten feet without delaying the mason.

Makers of cement-block machinery and dealers in the blocks consider about 260 blocks, including jambs and corners to be a fair amount to lay in an eight-hour day. The figures in our table are more conservative.

Table 1.—Laying Cement Blocks

(Time in hours per 100 blocks)

Mason, ...		3.8
Helper, ...		3.8
Mortar-man		1.9
Wheelers (per each 100 ft. distance to pile)		0.8
Loading or unloading trucks.—laborers hrs.		0.5
Add for each lin. ft. of corner or jamb to plumb,	masons hrs.	0.06
Add for each lin. ft. of ornamental projecting corners,	masons hrs.	0.05
Mortar, ...	cu. yds.	0.2

This table will hold good for walls up to 12 feet in height but, since cement block walls are seldom used for buildings having a greater storey-height, it is not necessary to compile a table for greater heights. When the building is more than one storey high allowance must be made for elevating, as explained in brick work.

The time for loading onto or unloading from wagons or trucks is given in the table, and knowing the weight of the blocks, the cost can be computed from the information contained in previous articles.

Example—Assume that we have a building 200 ft. long, 70 ft. wide and 12 ft. high, with 48 steel-sash each 6'-0" x 8'-6", 2 doors 10'-0" x 10'-0" and 3 doors 3'-0" x 7'-0" and we wish to compute the labor cost of laying the blocks.

The wall area is evidently:—

2 x 200=400		
2 x 70=140		
540 lin. ft. x 12 ft. high—		6,480
less		
48 x 6'-0" x 8'-6"	2448	
2 x 10'-0" x 10'-0"	200	
3 x 3'-0" x 7'-0"	63	2,711
	sq. ft.,	3,769

Disregarding the thickness of the joints.

3769x144 : 128=4,240 blocks required.

Assume laborers' rate, ... $0.45 per huor

Assume masons' rate, ... 0.90 per hour

Blocks delivered by trucks to site and unloaded 100 feet from working point.

For each 100 blocks the time to be consumed at the job is, therefore, as follows:—

Laborers,		
Unloading,	0.5 hr.	
Wheeling,	0.8 hr.	
Mortar-man	1.9 hr.	
Helper,	3.8 hr.	
	7.0 hrs. at .45=$3.15	
Mason,	3.8 hrs. at .90= 3.42	
Cost to lay 100 blocks		$6.57

But we must add the cost of plumbing the corners and jambs, which is:—

4 corners at 12 feet	48 lin. ft.
96 window jambs at 8½ ft.	816 lin. ft.
4 door jambs at 10 ft.	40 lin. ft.
6 door jambs at 7 ft.	42 lin. ft.
	946 lin. ft.
	at 0.06=56.76 hrs.

4 240 blocks laid at $6.57 per hundred,	$278.57
57 hrs. time plumbing corners, etc., at .90	51.30
Total labor cost,	$329.87

If we use a mortar made of 1 part cement, 3 parts sand and 10% lime putty, the cost of the mortar materials would be figured as follows.—

2.28 bbl. cement at 2.80	$6.38
0.08 bbl. lime at 4.00	.32
0.94 cu. yd. sand at 1.25	1.18
Per cu. yd.	$7.88
4 240 blocks at 0.2 cu. yd. per 100=	8.48 cu. yds.
8.48 cu. yds. at $7.88=	$66.82

The cost of scaffolding is figured as indicated in the article on brickwork.

Cost of Producing Blocks

No attempt is made here to cover completely the method of estimating the cost of producing the blocks since they are usually made in factories and delivered to the job at a fixed price per block. However, a few words on the subject will not be inappropriate.

The cost of making the blocks varies widely with the equipment used. I recently visited two apparently prosperous plants. One, using mechanical tampers, mechanical conveyors, industrial cars, etc., with a gang of eight men, working nine hours per day, turns out an average of 3,300 dry tamped blocks per day. The other plant, with all hand operations and a gang of three men at work, turns out 700 similar blocks per week.

Assuming a labor rate of 45 cents per hour, which is probably higher than actually paid, their costs would be as follows:—

Mechanical plant, 8x0.45x9÷3300=1 ct. per block.
Hand plant, 3x0.45x9x6 days÷700=10.41 cts. per block.

The cost of the materials used depends entirely upon the mix used, and most block-makers are not very definite in stating what mix they use. However, this may be roughly estimated by assuming that the usual mix is not much higher than 1 to 5, which requires 1.20 bbl. cement and 1 yd. sand per cubic yard.

Thus:—1.20 bbl. cement at 2.80	$3.36
1 cu. yd. sand at 1.25	1.25
1 cu. yd. mortar will cost	$4.61

Since each block of the size under consideration contains 704 cu. inches of mortar, a yard will make 27x1728÷704=66.2 blocks, which would mean that the material cost of each block would be approximately 7 cents.

Assuming usual overhead costs, the comparison of the two plants will be as follows:—

	Mechanical plant	Hand plant
Materials	.07	.07
Direct labor	.01	.104
Overhead (50% of labor)	.005	.05
Total	.085	.224

Whenever occasion requires that you make an estimate of the cost of producing cement-blocks, it is essential that you get complete data as to the equipment available, mixture to be used, size and cross-section of blocks, and all other factors which affect the cost.

Care should also be taken to differentiate between dry-tamped blocks and wet poured blocks.

Architectural Terra-cotta

I have an "Estimators' Hand-book" that says that "architectural terra-cotta, is of special design and has to be figured accordingly." That is very enlightening, except that the book does not tell how to figure it accordingly.

Architectural terra-cotta is essentially a manufactured product and the matter of estimating the cost of production is no more within the province of the construction manager than is estimating the cost of producing any other manufactured article.

It is true that the man who has carefully kept the data as to the cost of terra-cotta on previous jobs is in a position to approximate the cost of similar jobs in the future. However, the price of terra-cotta is varied by so many factors, such as finish, amount of ornament, number of times any piece is duplicated, color, etc., as well as manufacturing conditions and transportation costs, that it is always wise to get a definite quotation based upon the plans and specifications in every case.

Such a quotation may or may not include all necessary anchors. If it does not, then you should secure a list of those anchors from the manufacturers, or from the architect or the plans, and secure a price for them. When you cannot readily obtain a lump-price for the anchors, you can calculate their weight by the tables in structural steel hand-books and estimate their cost at the current price for builders' wrought iron work.

Setting architectural terra-cotta is an operation very similar to setting cut-stone work, except that its lighter weight usually obviates the necessity for using derricks with terra-cotta and, in those sections where the trades are separated, terra-cotta is more usually set by bricklayers than by stone-setters. When any fitting is necessary at the job that also is done by bricklayers, generally by those who are particularly expert in the work, rather than by stone-cutters.

On work involving any large amount of terra-cotta, it is well to make sure that the price made by the manufacturer includes the cost of necessary fitting to take care of any inaccuracies in the dimensions of the several pieces. It is hardly practicable for the builder to estimate the cost of fitting, since it may be absolutely nothing on one job and run to several hundred dollars on another and similar job.

When scaling quantities of terra-cotta from plans, be sure to take the full "squared" size of all mouldings, projections, capitals, columns, and similar members and multiply the dimensions into cubic feet. On that basis, the average weight will be between 70 and 75 lbs. per cubic foot and the cost of hauling may be figured accordingly.

The cost of the scaffold, when figured separately, may be computed according to the data given in the discussion of brickwork. There will be many times when the terra-cotta will be laid from the same scaffold as that used for the bricklaying, so no separate item need be made.

The cost of handling the terra-cotta from car to truck, truck to wheelbarrows, to the building, sorting and distributing it, as well as setting and cleaning down, may be computed from the following tables:—

Table 2.—Unloading, etc.

(Labor hours per 100 cubic feet

From car to truck	3
From truck to barrow	3
Wheeling 100 feet	3
Sorting and distributing	8

(Estimate cost of elevator as explained in brickwork)

Table 3.—Setting and Backing (per 100 ft.)

	Setting T. C.	Backing
Bricklayer	8 hrs.	4 hrs.
Laborer	16 hrs.	4 hrs
Mortar	0.16 cu. yd.	
Brick for backing		8 hrs.

Table 4.—Cleaning and Pointing

(Hours per 100 square feet)

	Washing Down New Work	Pointing New Work	Cleaning Old Work	Pointing Old Work
Mason	1.5	1.5	2	2
Laborer	0.75	0.75	1	1

Cut Stone Work

As with architectural terra-cotta, the production of cut-stone has become a manufacturing proposition and is seldom undertaken by a general contractor.

However, there are enough instances where a builder would undertake to produce the stone for a building operation to make it desirable for a construction manager to understand fully how the cost is estimated.

For the present, we shall content ourselves with learning how to estimate the cost of installing the stone in the building, as that is all that the building estimator generally finds it necessary to estimate himself.

Usually, when, there is any appreciable amount of stone to be used in a building, the companies bidding on it will name a lump-sum figure for all of the stone required. They will also usually give their estimate of the number of cubic feet to be set, thus relieving the general contractor of the necessity of scaling the quantities again, unless he desires to check the figures.

There are many items of stone-work, such as sills, lintels, pier-caps, chimney-caps, steps, bond-stones, etc., upon which it is possible to secure unit price lists in many localities, and when this is possible, it is well to be equipped with such lists and use them in estimating, even though you may have your own figures checked by sub-bids.

When using such lists, it is well to be very careful to make sure that the list covers exactly the same sizes, kinds of finish, etc., that are called for by the plans and specifications, as it is possible that there may be a very appreciable variation otherwise.

When any special work or ornamentation at all is required, it is well to get special prices.

The cubic-foot, as previously stated, is the most convenient unit for use in figuring stone-work but, of course, the number of cubic-feet that can be handled in a unit period of time will be determined by the size and weight of the individual pieces, their shape, and their position in the work.

Such items as sills, lintels, steps, pier-caps, etc., are usually set by hand, one or more laborers assisting the mason as may be required, but when ashlar facing is used, or when very much ornamental work, such as columns, cornices, etc., is included, it is usual to use a small hand-derrick or a breast-derrick.

Where the individual pieces are heavy, or where the total quantity to be handled runs into several thousand feet, it may be profitable to use a power derrick. However, this should be studied carefully, because it often develops that the mason will not handle the stone rapidly enough to pay the added cost of the power equipment and the men to run it, to say nothing of the cost of installation, fuel and removal.

The information given in previous articles will enable you to figure the cost of hauling, scaffolding, elevating, etc. The cost of loading and unloading will be determined by the facilities available. (See table 5).

If the stones are large, and no derrick is available for moving them from the car to truck and truck to building, the cost will naturally be higher than where the unloading facilities are good or the stones small.

The following tables contain the information necessary for the preparation of an estimate on any ordinary work.

Table 5.—Unloading Cut Stone

(Labor Hours per 100 Cubic Feet.)

	Hand Work	Hand Derrick	Power Derrick or Crane
From car to truck	4	3	2½
From truck to barrow or storage	4	3	2½
Wheeling in barrows per 100 feet	3		

Table 6.—Setting Cut Stone

(Hours per 100 Cubic Feet).

	Hand Work		
	Sills, Lintels, Etc.	Ashlar	Small Cornices
Masons	30	12	20
Laborers	30	20	30
	Using Hand Derrick		
Masons	24	10	15
Laborers	24	20	30
	Using Power Derrick		
	Heavy Foundation Stone	Thin Ashlar	Ornamental Work
Masons	4	8	12
Laborers	32	48	36
Engineer	4	4	4

Note—The figures for power derrick do not include the cost of installating and removing the derrick, which must be figured as will be explained in another article.

Most architectural stone-work must be laid in non-staining mortar, the composition of which is usually definitely specified by the architect. It is becoming usual to use white portland cement as the binding principal in non-staining mortars and when this is done, the tables given in the article on brickwork can be used in figuring the cost of the mortar, taking due account of the fact that the price of white cement is very much higher than that of the standard grey color.

The quantity of mortar required can be calculated from the following table:

Table 7.—Mortar Required

(Cu. Yds. Mortar per 100 Cubic Feet Stone).

	Setting	Pointing	Parging
Heavy foundation stone	0.10	0.03	
Thin ashlar work	0.15	0.05	0.15
Sills, lintels, etc.	0.15	0.05	0.15
Small ornamental work	0.13	0.04	0.13
Large ornamental work	0.13	0.04	0.13

Besides the cost of hauling, labor, elevating and mortar, we must include the cost of all anchors and clamps that are specified, being careful to note the number and kind as well as the material of which they are to be made and to get proper prices on them.

After the setting has been completed it will be necessary to wash the work down, using no acid for most stones, and the cost of such cleaning is to be calculated as follows:—

Table 8.—Cleaning and Pointing

(Hours per 100 Square Feet)

	Washing Down New Work	Pointing New Work	Cleaning Old Work	Pointing Old Work
Laborer	1	1	1.5	1.5
Mason	2	2	3	3

On work which has been exposed to weather for many years, particularly in communities where much soft coal is used, an ordinary washing down, even with a strongly alkaline wash, will not restore the stone to a satisfactory appearance. It is then necessary to resort to the use of a sand blast and the work is usually done by "stone-renovators" rather than by builders. In our discussion of cement-gun work we shall study the cost of sand-blasting, along with the other kinds of work for which the cement-gun may be used.

Let us assume for our example that we have a building front, to have a granite grade-course and a limestone-ashlar facing with the usual amount of ornamental work, such as pilasters, caps, bases, cornices, etc.

Our bill of quantities using the method mentioned in the discussion of architectural terra-cotta, and taking the "squared" dimensions of all members, is assumed as follows:—

Granite grade course	120 cu. ft.
Limestone ashlar	720 cu. ft.
Sills and lintels	150 cu. ft.
Ornamental features	600 cu. ft.
Total	1,590 cu. ft.

We will assume that the stone is to be delivered f. o. b. cars at the railroad station, one mile from the job over good hard roads, there is ample room at the work to pile the stone, but as the building is three stories high we shall have to hoist our stones by a power derrick which we will locate at a point that will serve the entire front and obviate the necessity for re-loading during the work.

To calculate the cost of bringing the stone from the railroad to the building, we will make use of the following table:—

Table 9.—Weights of Building Stone

Granite	170 lbs. per cu. ft.
Limestone	137 lbs. per cu. ft.
Sandstone	164 lbs. per cu. ft.
Bluestone	151 lbs. per cu. ft.
Marble	168 lbs. per cu. ft.
Gneiss	168 lbs. per cu. ft.
Slate	175 lbs. per cu. ft.

The total weight is, therefore.

120 cu. ft. granite at 170 lbs.	20.400
1,470 cu. ft. limestone at 137 lbs.	201,390
Total	221,790

Since we can handle 6,000 lbs. to the load, it follows that we shall have to haul 37 loads, which, at 2 miles per hour loaded and 3 miles per hour unloaded will require 50 minutes per load travelling time or practically 31 hours., to which must be added the time for loading and unloading. Allowing 2 men, and the driver, at the car, we find the loading time, from Table 5 to be 21.2 hours, and for unloading, using the derrick and the same number of men, the time will be 13.25 hours, giving a total of 65.45 hours.

The cost of the driver's time is included with the cost of the team, so is it only necessary to figure the cost of the other two men, or two thirds of the time indicated in the table, thus:

Loading 1.590 cu. ft.x4 hrs. per 100×2-3=42.4 hrs.
Unloading 1,590 cu. ft.x2½ hrs. per 100×2-3=26.5 hrs.

Total, 68.9 hrs.

assuming that enough teams are employed to keep the men busy,

The cost of the derrick engineer will be included in the cost of setting and need not be figured separately.

From Table 6, we find that the time required for setting the stone will be:

Ashlar Work, including sills, grade course, etc., 990 cu ft.

Masons at 8 hrs. per 100 cu. ft.	79.2 hrs.
Laborers at 48 hrs. per 100 cu. ft.	475.2 hrs
Engineer at 4 hrs. per 100 cu. ft.	39.6 hrs

Oramental Work, 600 cu. ft

Masons, @ 12 hrs, per 100 cu. ft.,	72 hrs.
Laborers at 36 hrs. per 100 cu. ft.,	216 hrs.
Engineers at 6 hrs. per 100 cu. ft.,	36 hrs.

Cleaning and Pointing 1,800 sq. ft., (from Table 8)

Masons at 4 hrs. per 100 sq. ft.,	72 hrs,
Laborers at 2 hrs. per 100 sq. ft.,	36 hrs,
Pole Staging Laborers,	15 hrs,

SUMMARIZING

Teams 65.5 hrs. at $1.00,		$65.50
Laborers, unloading, etc.,	68.9 hrs.	
Setting ashlar,	457.2 hrs.	
Setting ornament,	216. hrs.	
Cleaning & pointing,	36. hrs.	
Staging,	15. hrs.	
	811.1 hrs.	
	Say 811 hrs. at .45,	364.95
Masons, setting ashlar,	79.2 hrs.	
Setting ornament,	72. hrs.	
Cleaning & pointing,	72. hrs.	
	223.2 hrs.	
	say 223 hrs. at .90,	200.70
Engineer on ashlar,	39.6 hrs	
On ornament,	36. hrs.	
	75.6 hrs.	
	say 76 hrs. at .90,	68.40
Total direct labor cost,		$699.55

which equals .436 per cu. ft.

If this job could be set by hand, using a breast derrick and working from the floors as the building goes up, we should figure our costs as follows:—

The time of the teams in transit would be	31 hrs.
and at the car.	21.2 hrs.
the same as before, but their time at the building would be increased (See Table 5) to	21.2 hrs.
Total team time,	73.4 hrs.
The laborers time at the car would be	42.4 hrs.
as before, but the unloading time at the building would also be	42.4 hrs.
and we also have to allow for time needed in putting stones onto the elevator and taking them off at the upper stories. Assuming 360 cu. ft. of stone to go on the first floor, we have 1230 feet to raise to the upper stories and the distance to handle it will be taken as 100 feet, therefore, 1230 ft at 3 hrs. per 100=	36.9 hrs.
Total for these items,	121.7 hrs.

The time required for setting, from table 6, will be as follows:

	Masons	Laborers
270 cu. ft. Sills, Lintels, Grade Course, etc.	81. hrs.	81. hrs
720 cu. ft. Ashlar,	72. hrs.	144. hrs
600 cu. ft. Orament,	90. hrs	180. hrs.
Totals,	243. hrs	405. hrs.

The cost of cleaning and pointing will be as before, as also will the scaffolding, summarizing we get,

Team 73.4 hrs. at $1.00		$ 73.40
Laborers, unloading,	121.7 hrs.	
Setting	405. hrs.	
Cleaning & pointing,	36. hrs.	
Staging,	15. hrs.	
	577.7 hrs.	
	say 578 hrs. at .45,	260.10
Masons, setting,	243. hrs.	
Cleaning & pointing,	72. hrs.	
	315. hrs., at .90,	283.50
Engineer, 16 hrs. on elevator, at .90		14.40
Total direct labor,		$631.40

Which equals 39.7 cts. per cu. ft.

Without going into the matter of rental expense on the derrick and power, or the elevator, it can readily be seen that the stone-work on the building under construction can be handled to better advantage with a hand derrick than with a power-derrick.

This is not an invariable rule, yet it is not at all unusual for a job of this size, as the economy resulting from power equipment does not become effective until we handle much larger quantities of stone.

In Engineering News-Record of March 13, 1919, I described an instance where we completed some heavy repair work on a stone dam for less than four thousand dollars, with a hand derrick, though the estimates of our competitors, who contemplated the use of power equipment ran as high as thirty-nine thousand dollars.

That was an exceptional instance. It happened during a period of coal shortage, the nearest railroad was over two miles away and the conditions and the site were such that the cost of installing a steam-engine would have been equal to the total cost of operating the hand-derrick.

The Manufacture of Wood Stave Pipe

Present Day Practice in the Making of Wire Wound and Continuous Stave Pipe—Description of the Operations Involved—Wood Pipe is Being Widely Used

By J. B. HOLDCROFT, A.M.E.I.C.

Historically, wooden pipe is no new thing, but until a comparatively few years ago it was frankly a makeshift—bored out logs jointed by tapering or by slipping in tenon pieces made of sheet iron. Work of this kind has been done as far back as the seventeenth century, and makeshift though it was, many of these old jobs were in service for two hundred years or more. But it has been reserved for this age of machinery to make it possible to use these durable wooden pipes under the high heads required by modern conditions.

Present day practice calls for a pipe built in staves, with a wrapping of wire which is proportioned to take the entire pressure load. The wall of the pipe is ordinarily comparatively thin, not over one and one-half inches, for the reason that dependence is placed upon this fact to secure continuous saturation of the entire volume of the wood—the principle being now well established that wood so saturated will not decay during any period of which we have record. Very large pipes, however, are built with a thicker stave than this to obtain the necessary mechanical strength and rigidity.

The manufacturing process is one of considerable interest, and in its present condition represents the accumulated experience of a long period of years—a period which has seen the evolution of this material, for it is now well established as one of the standard materials of construction in its field, from a little known product used almost entirely in the West and looked upon askance by conservative engineers.

Apart from the care and study expended upon the development of the material, its phenomenal success is due primarily to two of the woods of the Pacific Coast—the redwood of California, where the pipe was first used, and later the Douglas or British Columbia fir. High pressures require a hard, close-grained wood of high tensile and compressive strength, and further require perfectly clear stock of slow growth and entire freedom from knots or other defects.

The wood is usually purchased in the standard mill sizes 2" x 4" or 2" x 3" and of the qualities known commercially as "Nos. 1 & 2 clear," and for the smaller sizes of pipe of which a large footage is made for constant shipment, is nearly always kiln dried. Air seasoning is, of course, more satisfactory when possible, and is used as far as practicable for the larger sizes and for the stock used in the manufacture of continuous pipe staves. The Pacific Coast climate allows of satisfactory seasoning in from six to twelve months according to one company's experience, and large stock piles of lumber are always kept in the yard undergoing this process.

The Manufacture of Wire Wound Pipe

Following first the manufacture of what is known as "wire wound" pipe, which is manufactured complete in the factory and only requires jointing on the job like ordinary iron pipe—the staves are dressed to the radius of the pipe being made, the edges conforming to a true sector, and a bead and groove are formed in a single passage through the machine, which is to all intents and purposes an ordinary planer, with the special attachments necessary for forming the stave. Each length of pipe is then assembled in a sort of cradle and a temporary clamp put on which holds the staves in place while the end of the winding wire is being attached, which is done

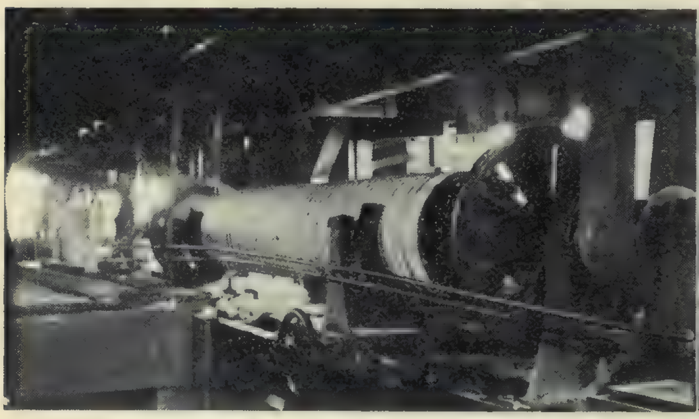
Stock pile of continuous stave pipe sections on shipping platform

Assembling pipe and windng machne

by hooking the end around a staple driven into the pipe.

The winding machine is most ingenious, and can be adjusted to put any desired tension on the wire, and to space it according to the pressure the pipe will have to stand, a different winding being set for each size of pipe, and for each difference of 50 feet head of water. Sleeves are made in the same manner, of a diameter sufficient to drive onto the end of the pipe. From the winder the pipe passes to the tenoning machine, where the joint is finished. This is a machine not unlike a lathe in appearance, but with the difference that the pipe remains stationary while the cutter knives revolve at high speed. These form the end of the pipe so that it will easily enter the sleeve and will tighten up to a perfectly watertight joint as the pipe is driven home. No calking material whatever is intended to be used.

The completed pipe then rolls down an incline into a shallow bath of hot tar. The depth of tar is kept so that none can enter the interior of the length, and as the pipe is rolled across the bath the outer surface is thoroughly coated, thus protecting not only the wood but thoroughly coating the wire winding also—one of the most important requirements, as obviously, pipe of this kind can last no longer than its wire. Finally, as the length of pipe reaches the other side of the tar bath, it is lifted out, and started down another incline which is kept constantly covered with clean sawdust, of which enough is picked up by the hot tar coating to form a thick protective covering, protecting the tar from injury in transit and making it much easier to handle the material.


Length of 24 in., pipe in the tenoning machine

Tarring outside of wood stave pipe

Increasing the Durability

There are a number of variations of this process, chiefly in connection with ensuring the durability of the pipe under certain trying conditions. It has been found that perfect saturation is not always obtained in the sleeve connections, and that they consequently are inclined to suffer from dry-rot. So it is becoming an occasional practice to have the sleeves pressure treated with creosote to obviate this danger. And where the pipe system is to be alternately full and empty, as on irrigation systems, it is regarded as economical to have the whole pipe treated in that way, while a cheaper method, also frequently resorted to, is to simply dip the completed pipe in creosote before tarring. While little penetration is secured by this latter method the degree of protection afforded is considerable.

"Wire wound" pipe construction is, however, used principally for small sizes and for more or less temporary purposes in the larger sizes, up to 24 inch. Nearly all the wooden pipe used for power penstocks and large watermains is of the "continuous stave" type, which was also the original type developed when wooden pipes first became a definite factor in engineering practice. One advantage of the continuous stave pipe is that it is shipped to the job in knocked down form, and consequently is more easily transported than any other type of conduit. The winding of the factory made pipe is replaced in this form of construction by bands made of round iron, the ends of which pass through a saddle shaped to the circumference of the pipe, where they are tightened up by nuts screwed on to the threaded ends of the rods. As with the other type, the size of bands and their spacing is suited to the pressure the pipe will have to stand at any particular point.

The mill work on this pipe is therefore confined to the manufacture of the staves and bands, no assembling being done until the site of the work is reached. A separate operation which has to be performed on each end of every stave length is the cutting of a spline or key-way, into which is fitted, during construction, a strip of sheet iron which forms a seal and prevents leakage of water past the ends of the staves. A machine for this special purpose, with a horizontal saw which makes the required cut in the end of each stave, is located near the shapers and is the key point of the process, as any delays or accumulations usually occur there.

As an example of the work that may be done with this class of pipe, it may be mentioned that the largest pipe built so far is one of 14 feet diameter, which was installed by the Pacific Coast Pipe Co. at Niagara Falls on the Ontario Power Company development of the Hydro-Electric Power Commission of Ontario. Other pipes of large diameter have been installed in various parts of Canada, and mention can be made of one of 10 feet diameter in the Musquash development of the New Brunswick Electric Power Commission, one of the same size on the St. Margaret's bay development of the Nova Scotia Power Commission, and one of 6 feet diameter on one of the Granby developments in British Columbia. The very large pipes mentioned are not subjected to extreme head, but it is interesting to note that it is considered good practice to use pipes of 36 inch to 42 inch diameter under heads as great as 470 feet. To show the extent to which these pipes are coming into use in Canada, now that the soundness of the construction as a definite type has been satisfactorily established, it may be mentioned that one factory's output of all sizes for a year has at times run as high as 50 miles.

Construction Developments During the Month of October

Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded and Contemplated

Construction Contracts Awarded in Eastern Canada, October, 1922

	Ontario		Quebec		New Brunswick		Nova Scotia		Eastern Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	2	$ 85,000	2	$ 150,000	....	$	....	$	4	$ 235,000
Churches	6	46,000	4	313,800	....	....	1	25,000	12	393,800
Factories	12	450,000	6	187,000	....	....	....	....	18	637,000
Public Garages	20	193,000	27	129,000	3	16,000	1	1,500	51	339,500
Hospitals	2	25,000	....	....	....	....	1	115,000	3	140,000
Hotels and Clubs	4	54,600	2	15,500	....	....	....	....	6	70,100
Office Buildings	7	543,800	6	185,500	....	....	....	....	13	729,300
Public Buildings	3	220,000	2	274,400	....	....	1	4,000	6	498,400
Residences	890	4,368,300	443	2,818,900	28	130,700	26	110,300	1388	7,432,700
Schools	15	1,499,300	6	159,500	1	4,000	1	2,000	23	1,664,800
Stores	55	656,500	18	284,400	1	15,000	3	12,000	78	974,900
Theatres	2	170,000	....	....	....	....	....	....	2	170,000
Warehouses	7	97,500	2	16,000	1	10,000	....	....	10	123,500
Total Buildings	1025	$8,409,000	518	$4,534,000	34	$ 175,700	34	$ 269,800	1614	$13,409,000
Bridges	3	$ 11,900	9	$ 59,900	2	$ 13,000	....	....	14	$ 84,800
Dams and Wharves	4	196,100	4	43,900	....	....	3	21,400	11	261,400
Sewers & Watermains.	12	87,900	....	....	....	....	....	....	12	87,900
Roads and Streets	9	547,300	11	228,900	....	....	....	....	20	776,200
General Engineering	24	3,131,500	3	259,300	....	....	2	20,000	29	3,410,800
Grand Total	1077	$12,383,700	545	$5,126,000	36	$ 188,700	39	$ 311,200	1700	$18,030,100

Construction Contracts Awarded in Western Canada, October, 1922

	British Columbia		Alberta		Saskatchewan		Manitoba		Western Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	2	$ 9,500	....	$	....	$	1	$ 4,000	3	$ 13,500
Churches	1	55,000	1	5,600	....	....	2	6,800	4	67,400
Factories	2	22,500	1	2,500,000	....	....	4	62,000	7	2,584,500
Public Garages	2	25,000	2	12,500	....	....	3	80,700	7	118,200
Hospitals	....	....	....	....	....	....	2	73,000	2	73,000
Hotels and Clubs	4	45,000	1	3,500	....	....	1	2,000	6	50,500
Office Buildings	....	....	1	15,000	3	57,500	2	33,000	6	105,500
Public Buildings	1	5,000	2	9,800	....	....	2	10,800	5	25,600
Residences	131	552,300	19	55,400	73	248,800	71	256,900	294	1,113,400
Schools	3	8,000	13	239,000	6	28,000	3	19,700	25	294,700
Stores	8	78,000	1	5,000	5	25,500	11	68,300	25	176,800
Theatres	1	3,000	....	....	....	....	....	....	1	3,000
Warehouses	4	21,000	....	....	2	15,000	2	10,000	8	46,000
Total Buildings	159	$ 824,300	41	$2,845,800	89	$ 374,800	104	$ 627,200	393	$4,672,100
Bridges	1	1,250,000	....	....	....	....	3	7,200	4	1,257,200
Dams and Wharves	1	5,000	....	....	....	....	....	....	1	5,000
Sewers & Watermains.	....	....	....	....	....	....	1	4,800	1	4,800
Roads and Streets	1	25,000	....	....	1	10,600	....	....	2	35,600
General Engineering	3	265,500	....	....	....	....	....	....	3	265,500
Grand Total	165	$2,369,800	41	$2,845,800	90	$ 385,400	108	$ 639,200	404	$6,240,200

Contemplated New Construction Work in Canada, October, 1922

	Ontario		Quebec		Maritime		Western		Dominion	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	2	$ 70,000	3	$ 120,000	....	$	....	$	5	$ 190,000
Churches	7	119,500	6	395,000	2	115,000	2	9,500	17	639,000
Factories	17	896,000	3	77,000	1	100,000	10	3,637,000	31	4,710,000
Public Garages	14	197,500	4	165,000	....	....	3	19,000	21	381,500
Hospitals	2	1,007,500	....	....	....	....	....	....	2	1,007,500
Hotels and Clubs	2	70,000	1	25,000	....	....	3	17,500	6	112,500
Office Buildings	6	180,000	2	85,000	....	....	4	33,500	12	298,500
Public Buildings	8	240,500	3	285,000	....	....	6	117,000	17	642,500
Residences	333	1,843,900	58	668,500	13	62,000	11	82,300	415	2,656,700
Schools	11	960,000	9	541,000	2	155,000	13	74,500	35	1,730,500
Stores	10	132,000	2	33,000	1	20,000	9	90,500	22	275,500
Theatres	....	....	1	5,000	....	....	....	....	1	5,000
Warehouses	3	140,000	2	125,000	....	....	3	36,000	8	301,000
Total Buildings	415	$5,856,900	94	$2,524,500	19	$ 452,000	64	$4,116,800	592	$12,943,400
Bridges	2	106,000	3	98,500	2	48,000	3	40,800	10	293,300
Dams and Wharves	1	100,000	2	21,000	....	....	3	32,000	6	153,000
Sewers & Watermains.	18	356,500	8	245,000	2	6,600	12	70,800	40	678,900
Roads and Streets	16	281,500	12	498,500	....	....	5	78,500	33	858,500
General Engineering	6	774,400	2	70,000	2	80,000	6	80,000	16	1,004,400
Grand Total	458	$7,475,300	121	$3,457,500	25	$ 586,600	93	$4,118,900	697	$15,938,300

Nov. 15, 1922

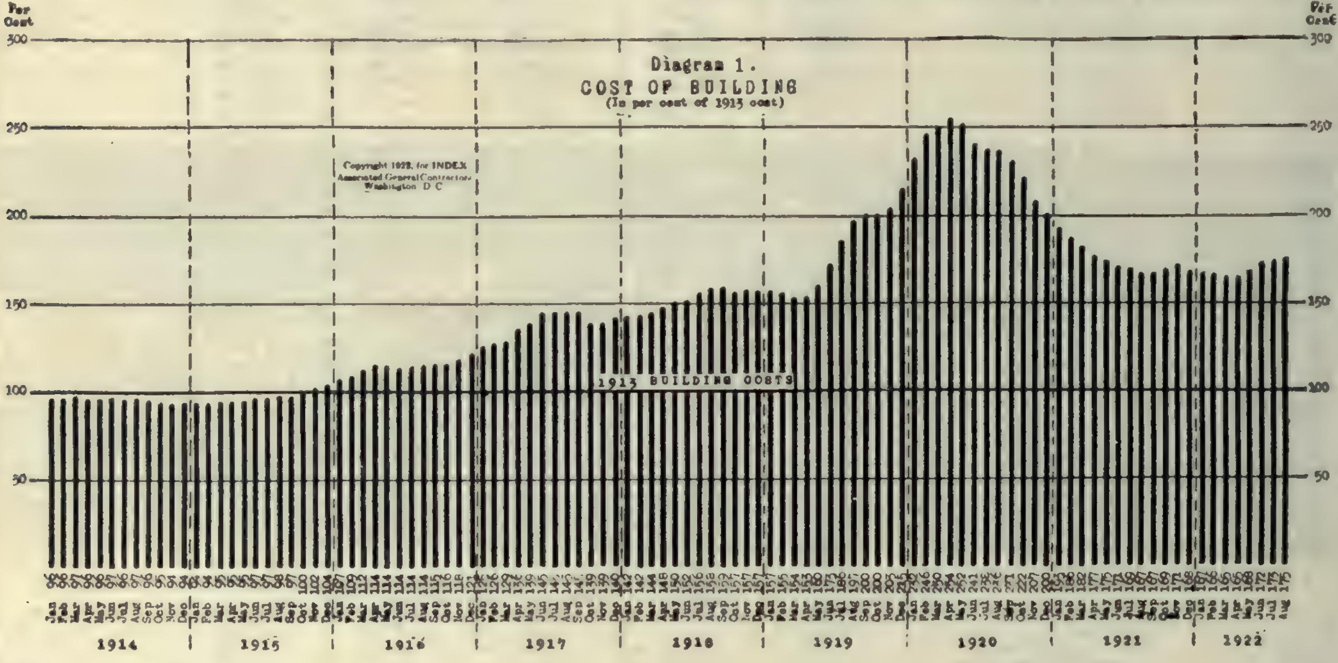
Are Building Costs Permanently High?

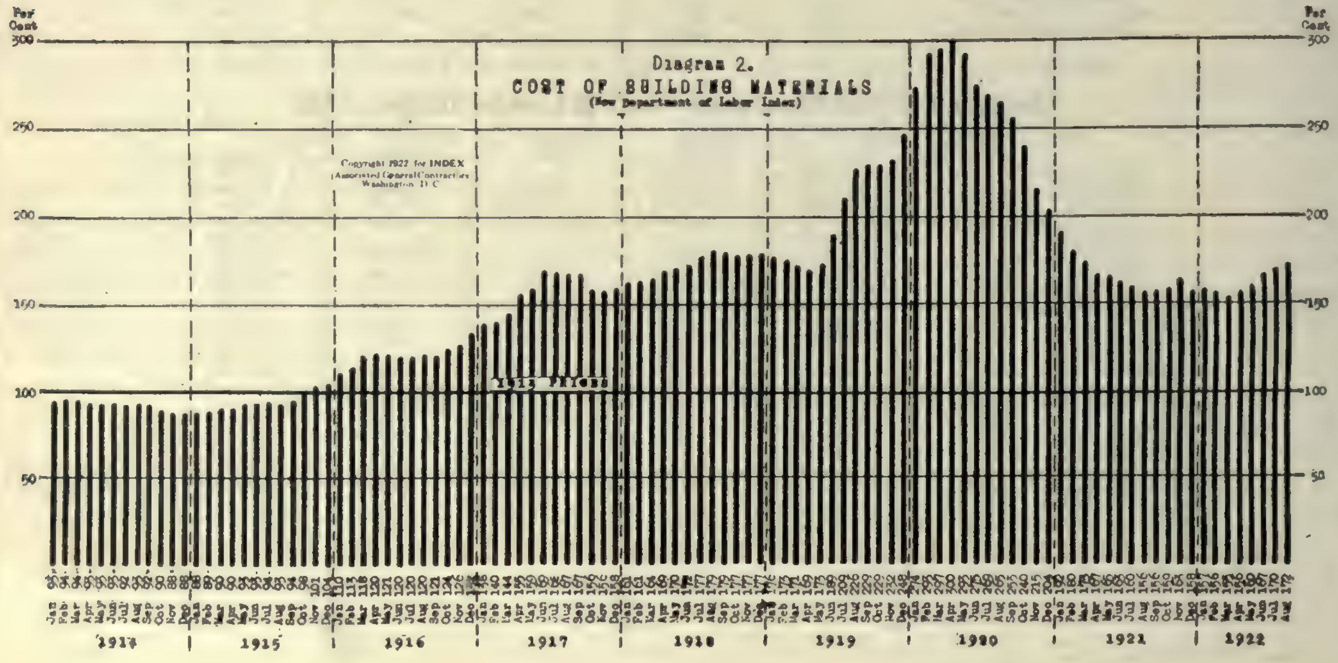
Investigations Made by the Associated General Contractors of America Show How the Prices of Building Materials and Labor Have Been Fluctuating

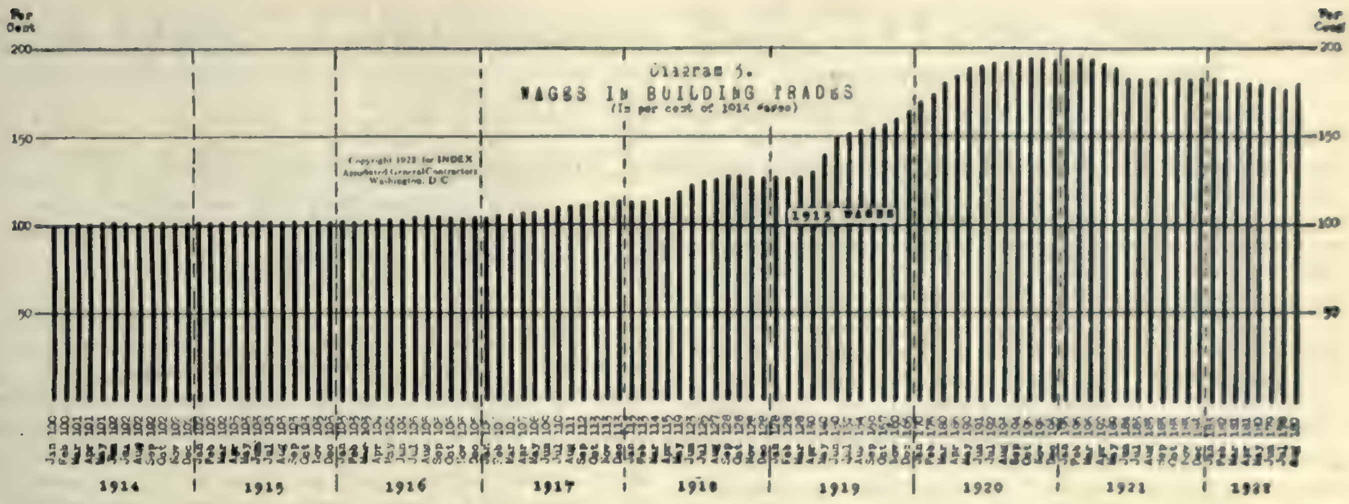
By M. V. Ayres in "The Constructor," the official publication of the A. G. C.

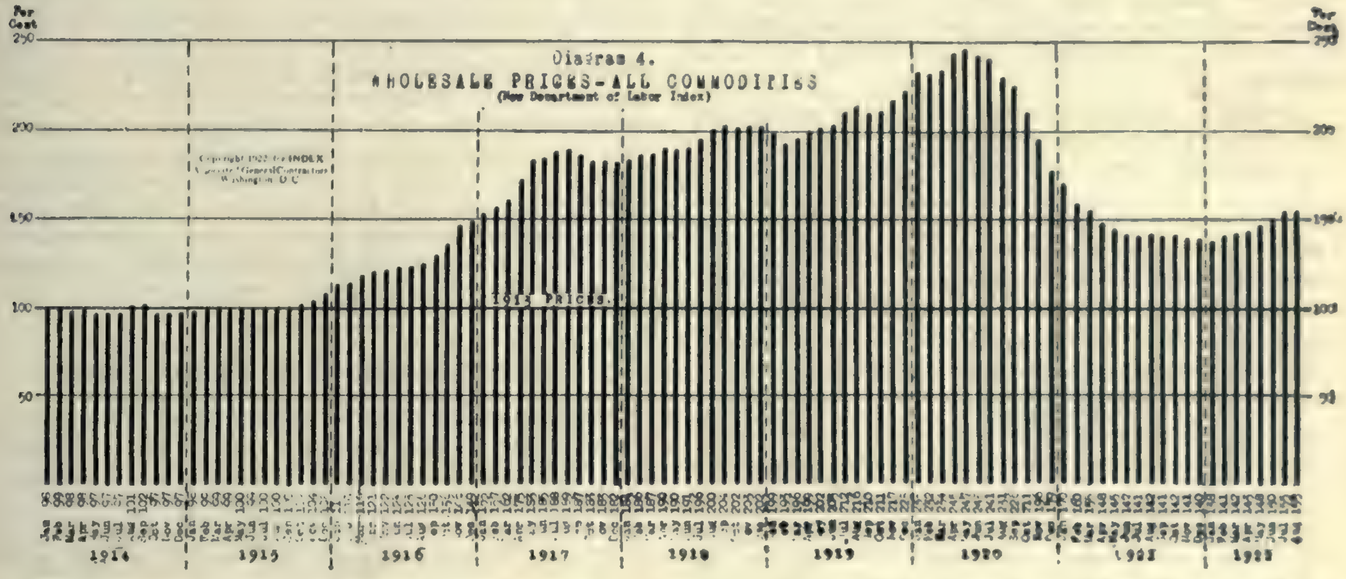
One of our members has asked us to furnish him with figures showing why houses cost more today than they did in 1914 or in 1918. He wishes to use these figures as the basis of an argument to convince prospective home builders that they must expect to pay more for new houses, built at this time, than they would have had to pay for similar dwellings in 1914 or in 1918. This report has been prepared particularly with a view to supplying the information requested and, at the same time, affording assistance to other readers who are in need of similar arguments in connection with their business.

Diagram 1 shows how the cost of building has varied from month to month since the beginning of 1914. The heights of the columns are proportional to the average building cost for each month in comparison with the average cost for the year 1913, which is taken as 100 per cent. and is represented by the height of the heavy line across the diagram marked "1913 Building Cost." It will be evident from the diagram that building costs are now 75 per cent. greater than they were in 1913, and exceed the corresponding figures for any month prior to July, 1919. The cost of building was very much greater









in 1920 than now, reaching a maximum in April of that year of more than two and one-half times the pre-war figure. It then dropped each month until August, 1921; since which time it has had some ups and downs, and for the past four months has been increasing at a rather alarming rate.

The figures used in constructing the above diagram have been obtained by combining figures which represent the average cost of building materials with data which show the average wage rates in the building trades. Diagrams 2 and 3 respectively, show how the building material prices and wages have varied since 1913.

Material and Wage Indexes

Diagram 2 represents the index of building material prices computed by the Department of Labor. This index is a composite of the prices of some 40 different building materials for which quotations are obtained from a large number of different points. This average figure for building materials cost reached its height in April, 1920, when it was three times as great as in 1913.

Diagram No. 3 shows how wages in the building trades have varied during the same period covered by the other diagrams. Wages did not go nearly so high as materials. They reached their greatest height at a later period, and they have not since come down very much. These wage figures are averages of the wages paid in 11 of the building trades, in eight representative cities. The index of the cost of building represented by Diagram 1 is a composite of the material index and the wage index shown in Diagrams 2 and 3 in which the former represents 60 per cent., and the latter 40 per cent. of the final result.

The Reason

The prospective builder, after studying these three diagrams, will be obliged to admit that neither houses nor any other class of buildings can be erected today for the amount of money which they would have cost either in 1914 or in 1918. If he still balks, however, at the necessity of paying more than he formerly did, it should be pointed out to him that that is precisely what he is obliged to do in making practically any other sort of a purchase whatever. Diagram 4 shows how wholesale prices of all commodities have varied since 1913. It will be noted that the general shape of the diagram is very similar indeed to that representing the cost of building. To be sure average prices did not go quite so high in 1920, and they are not quite so high now as the price of building materials or the cost of completed buildings. This diagram represents the index of wholesale prices of the Department of Labor, and is a composite of the prices of over 400 different commodities. It includes a number of important items, such as zinc, tin, copper and rubber, which for special reasons easily explained in each case are now selling at below the pre-war figures. This helps to explain why the index of wholesale prices is at a lower point than that of building materials.

Prices at Permanent New Level

It will be noted that every one of the diagrams thus far referred to shows an increase in prices during the past few months. This is what always happens to prices when business is recovering from a depression. It was to have been expected. It does not mean that prices are going back to where they were in 1920. It probably does not mean that they are going very much higher than they now are, but it is a very strong argument for the contention that prices have settled down to a relatively permanent new price level. In other words, for some years to come prices will probably fluctuate in accordance with the ebb and flow of general business prosperity above and below some average point located at just about the present level. Anyone who proposed to postpone building until prices are down to the 1913 figure should incorporate the specifications in his will because they will probably not be carried out in his lifetime.

It may well be that some time in the future, perhaps 20 years from now, the general average of prices may again be down to the 1913 figure or below it. But, if we are to judge by past history, building costs will probably not go down in equal ratio, because the cost of lumber has been steadily increasing for many years and is destined to go on increasing on account of the progressive destruction of our forests. Today, in many parts of the country where buildings used to be constructed of lumber cut close by, wood is now being used the cost of which is more than half represented by freight charges.

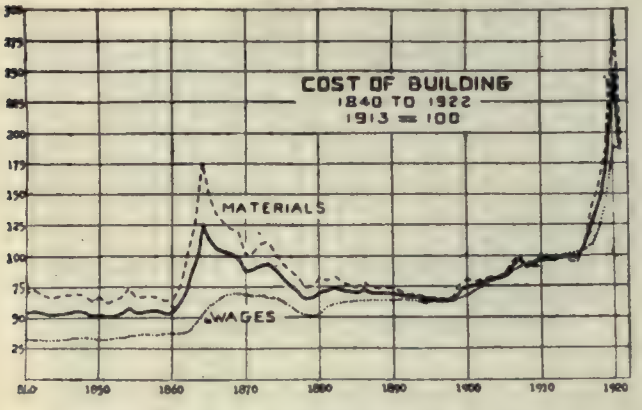


Diagram 5—Cost of building from 1840 to 1921

Ups and Downs of the Past

To anyone who thinks that the general trend of the cost of building is likely to be downward, we commend a careful inspection of Diagram 5 showing how the cost of building has varied since 1840. This shows that the 1913 average, which so many people now look upon as the normal cost, was just twice as high as the figure for 1850.

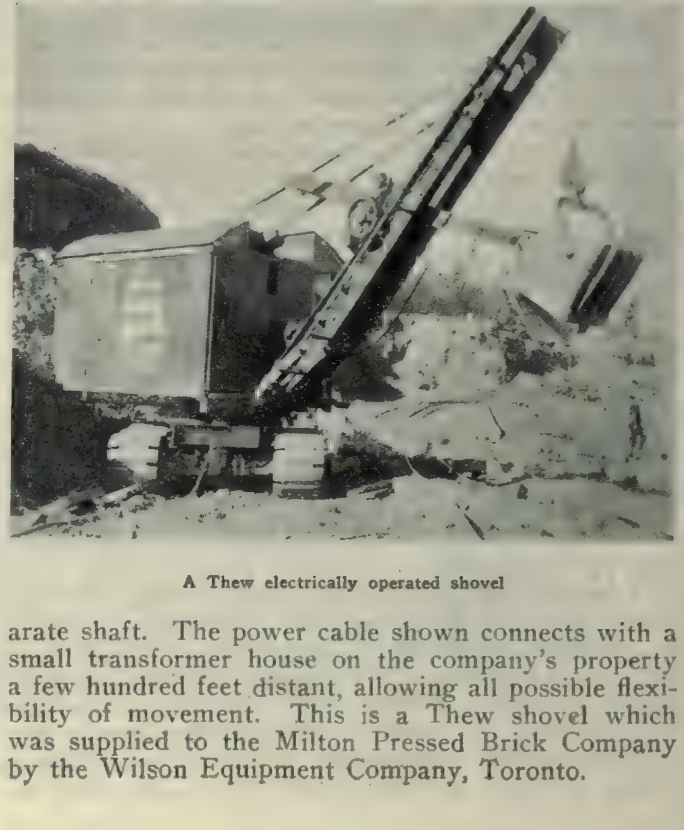
Although the cost of building materials was almost exactly the same in 1898 as in 1850, wages of building labor were about twice as great in the later year as in the earlier year. This difference in the behavior of wage rates and the prices of materials is due to a great fundamental cause, which has been operating throughout the period shown on the diagram and is still operating even more powerfully than it was some decades ago. This fundamental cause is the constantly increasing use of labor-saving machinery and methods, which are constantly increasing the per capita production of commodities and thereby increasing the quantity of the desirable things of life to which each individual is entitled. It therefore follows that, if the price of materials remains relatively constant, wage rates must continually increase in order that the workers may be able to purchase their increasing share of these products.

The Conclusion

The diagram shows that following the peak between 1860 and 1870 and the subsequent depression there was, beginning with 1870, a period of about two and one-half years during which the price of building materials increased and also the cost of building. We seem to be now experiencing the beginning of a similar rise in prices. It is not safe, however, to figure on a close parallel between the course of prices in the present period and their course in the years following the Civil War. While there is a very marked general similarity between the two periods, there are very many important conditions which are widely different. We may safely conclude however, that the extreme price changes of the war period are passed; that if prices in general again reach their pre-war level it will only be after many years; that wages will probably never go down to their pre-war level; and that the total cost of building, likewise. is permanently higher than it was before the war.

Electric Shovel in Brick Plant

Modern equipment is a necessary factor in the efficient operation of brick manufacturing. The modern shovel shown herewith is part of the equipment of the Milton Pressed Brick Company. It is electrically operated throughout, utilizing one 25 horse-power motor, the traction being developed through a separate shaft. The power cable shown connects with a small transformer house on the company's property a few hundred feet distant, allowing all possible flexibility of movement. This is a Thew shovel which was supplied to the Milton Pressed Brick Company by the Wilson Equipment Company, Toronto.



A Thew electrically operated shovel

Canadian Contractors now Have Standard Form of Contract

The Association of Canadian Building and Construction Industries Have Developed a Contract Form, Including a Set of General Conditions, That Is Fair to All Parties Concerned

Did you ever have your banker say to you: "Why did you sign such a contract?"

Did your lawyer ever ask you: "Why didn't you bring the contract to us before you signed it instead of waiting until you got into trouble?"

The trouble was, of course, that you had to contract or go out of business. Possibly you did not look at the form you signed in your anxiety to get the job.

One of the aims of the Association of Canadian Building and Construction Industries has been to produce a standard form of contract which would be fair to owner, architect, and contractor. After a thorough study of many existing forms, consultations with architectural and engineering authorities, and securing the best legal advice, such a standard contract form has been developed. It consists of a simple brief agreement, and a standard set of general conditions. We believe it to be a simple, but at the same time a complete contract form, suited to the various classes of construction work in Canada. We are advised that copies of the form may be obtained through the secretary of the local association or direct from the head office at a cost of 15 cents a copy or $1.50 per dozen.

The form which is called "A Standard Form of Agreement between Contractor and Owner" is printed below, the following explanatory note being prefaced to the agreement.

Explanation.—A committee of this association, assisted by engineering and architectural representatives from other bodies, discussed this agreement for over one year, and in that time they considered altogether nineteen existing contract forms in use throughout Canada and the United States, under the best legal guidance. It is the belief of this association that the document as now issued is clear and concise, as brief as possible, as complete as it can be made and, lastly, that is is well balanced and above all things, fair to the owner, to the architect or engineer, and to the contractor.

It is designed for use in any province of Canada, and for any class of construction work.

To the Architect or Engineer.—You will find the general conditions attached to the agreement proper complete in every detail. By using this standard document, you can start right in on your technical specifications.

Instructions re completing Article III of the agreement:

1st blank is for the contract amount.

2nd blank is for the monthly date of payment.

3rd blank is for the general percentage of retention or holdback on the whole contract.

4th blank under normal conditions will not be filled in. If provision is required for payment of finished materials (such as cut stone, steel, cement, etc.) delivered to, or lying on some yard or other site, such provision will be inserted.

5th blank; If the architect or engineer wishes to retain the full percentage of holdback until the final completion, then the 3rd and 5th blanks will contain the same figure. If the contract is of a magnitude to warrant a lesser percentage being held back when the work is substantially completed, then this blank will name such lesser percentage.

6th blank covers the period of retention.

7th blank is for any special provisions.

The Standard Form of Agreement Between Contractor and Owner

(For use when a stipulated sum forms the basis of payment, and to be used only with the standard general conditions of the contract.)

This agreement made the ...... day of ...... in the year Nineteen hundred and ...... by and between ...... hereinafter called the Contractor, and ...... hereinafter called the Owner.

Witnesseth: That the Contractor and the Owner for the considerations hereinafter named agree as follows:

Article I.—The Contractor agrees to provide all the materials and to perform all the work shown on the drawings and described in the specifications entitled (here insert the caption descriptive of the work as used in the proposal, general conditions, specifications, and upon the drawings.) Prepared by ...... acting as, and in these contract documents entitled the architect, and to do everything required by the general conditions of the contract, the specifications, and the drawings.

Article II.—The Contractor agrees that the work under this contract shall be substantially completed (here insert the date or dates of completion, and stipulations as to liquidated damages, and bonus if any)

Article III.—The Owner agrees to pay the Contractor in current funds for the performance of the contract ...... ($........) subject to additions and deductions in the general conditions of the contract, and to make payments on account thereof as provided therein, as follows: On or about the ...... day of each month ...... per cent of the value, proportionate to the amount of the contract, of labor and materials incorporated in the work or delivered at the site ...... up to the first day of that month as estimated by the Contractor and approved by the Architect, less the aggregate of previous payments; on substantial completion of the entire work, the balance due under this contract less the value of any unfinished work, a sum sufficient to increase the total payments to ...... per cent of the contract price, and ...... days thereafter, provided the work be fully completed and the contract fully performed, the balance due under the contract.

Article IV.—The Contractor and the Owner agree that the general conditions of the contract, the specifications and the drawings, together with this agreement, form the contract, (all of which must be identified by signature of the parties) and that they are as fully a part of the contract as if hereto attached or herein repeated; and that the following is an exact enumeration of the specifications and drawings:

The contractor and the owner for themselves, their successors, executors, administrators and assigns, hereby agree to the full performance of the covenants herein contained.

In witness whereof they have executed this Agreement, the day and year first above written, etc.

The General Conditions of the Contract

Article 1.—Principles and Definitions

(a) The Contract Documents consist of the Agreement, the General Conditions of the Contract, the Drawings and Specifications, including all modifications thereof incorporated in the documents before their execution. These form the Contract, when signed by the Owner and Contractor.

(b) The Owner, the Contractor and the Architect are those named as such in the agreement. The term "Architect" shall be read as Engineer when the work is to be performed under the supervision of an Engineer.

(c) The term Sub-contractor, as employed herein, includes only those having a direct contract with the Contractor and it includes one who furnishes material worked to a special design according to the plans or specifications of this work, but does not include one who merely furnishes material not so worked.

(d) Written notice shall be deemed to have been duly served if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered mail to the last business address known to him who gives the notice.

(e) The term "work" of the Contractor or Subcontractor includes labor or materials or both.

(f) The law of the place of building shall govern the construction of this contract.

Art. 2.—Execution, Correlation and Intent of Documents.—The Contract Documents shall be signed in duplicate by the Owner and Contractor.

The Contract Documents are complementary, and what is called for by any one shall be as binding as if called for by all. The intention of the documents is to include all labor and materials reasonably necessary for the proper execution of the work. It is not intended, however, that materials or work not covered by or properly inferable from any heading, branch, class or trade of the specifications shall be supplied unless distinctly so noted on the drawings. Materials or work described in words which so applied have a well known technical or trade meaning shall be held to refer to such recognized standards.

Art. 3.—Detail Drawings and Instructions.—The Architect shall furnish, with reasonable promptness, additional instructions, by means of drawings or otherwise, necessary for the proper execution of the work. All such drawings and instructions shall be consistent with the Contract Documents. The work shall be executed in conformity therewith and the Contractor shall do no work without proper drawings and instructions. In giving such additional instructions, the Architect shall have authority to make minor changes in the work, not inconsistent with the Contract.

The Contractor and the Architect, if either so requests, shall jointly prepare a schedule, subject to change from time to time in accordance with the progress of the work, fixing the dates at which the various detail drawings will be required, and the Architect shall furnish them in accordance with that schedule. Under like conditions, a schedule shall be prepared, fixing the dates for the submission of shop drawings, for the beginning of manufacture and installation of materials and for the completion of the various parts of the work.

Art. 4.—Copies Furnished.—The Architect shall furnish to the Contractor, free of charge, at least three copies of each full-sized detail drawing and as many copies of other drawings and specifications as are reasonably necessary for the proper execution of the work, in addition to a signed copy of the Contract Documents.

Art. 5—Shop Drawings.—The Contractor shall furnish to the Architect, at proper times, all shop and setting drawings or diagrams which the Architect may deem necessary in order to make clear the work intended or to show its relation to adjacent work of other trades. The Contractor shall make any changes in such drawings or diagrams which the Architect may require consistent with the Contract, and shall submit two copies of the revised prints to the Architect, one of which shall be returned to the Contractor and the other retained by the Architect. When submitting such shop and setting drawings the Contractor shall notify the Architect in writing of every change made thereby from the Architect's drawings or specifications. The Architect's approval of such drawings or of the revised drawings shall not relieve the Contractor from responsibility for errors made by the Contractor therein or for changes made from the Architect's drawings or specifications not covered by the Contractor's written notification to the Architect. All models and templates shall conform to the spirit and intent of the Contract Documents.

Art. 6.—Drawings and Specifications on the Work.—The Contractor shall keep one copy of all drawings and specifications on the work, in good order, available to the Architect and to his representatives.

Art. 7.—Ownership of Drawings and Models.—All drawings, specifications and copies thereof and all models furnished by the Architect are his property. They are not to be used on other work and, with the exception of the signed contract set of the drawings and specifications, are to be returned to him on request on the completion of the work. Any models furnished by the Contractor or the Owner are the property of the Owner.

Art. 8.—Samples.—The Contractor shall furnish for approval all samples as directed. The work shall be in accordance with approved samples.

Art. 9.—The Status of Architect and Contractor.—The Architect shall have general supervision and direction of the work, but the Contractor shall have complete control, subject to Article 11, of his organization.

Art. 10.—The Architect's Decisions.—The Architect shall in the first instance decide on questions arising under the Contract Documents, whether as to the performance of the work, the interpretation of the specifications and plans or otherwise, but except as otherwise expressly provided in these general conditions or in the specifications, all the Architect's decisions shall be subject to arbitration.

Art. 11.—Foreman, Supervision.—The Contractor shall keep on his work, during its progress, a competent foreman and any necessary assistants, all satisfactory to the Architect. The foreman shall not be changed except with the consent of the Architect, unless the foreman proves to be unsatisfactory to the Contractor and ceases to be in his employ. The foreman shall represent the Contractor in his absence and all directions given to him shall be as binding as if given to the Contractor. Important directions shall be confirmed in writing to the Contractor. Other directions shall be so confirmed on written request in each case.

The Contractor shall give efficient supervision to the work, using his best skill and attention. He shall carefully study and compare all drawings, specifications and other instructions and shall at once report to the Architect any error, inconsistency or omission which he may discover.

Art. 12.—Materials, Appliances, Employees.—Unless otherwise stipulated, the Contractor shall provide and pay for all materials, labor, water, tools, equipment, light and power necessary for the execution of the work.

Unless otherwise specified, all materials shall be new and both workmanship and materials shall be of specified quality.

The Contractor shall not employ on the work any unfit person or anyone not skilled in the work assigned to him.

Art. 13.—Inspection of Work.—The Owner, the Architect and their representatives shall at all times have access to the work wherever it is in preparation or progress and the Contractor shall provide proper facilities for such access and for inspection.

If the Specifications, the Architect's instructions, laws, ordinances or any public authority require any work to be specially tested or approved, the Contractor shall give the Architect timely notice of its readiness for inspection, and if the inspection is by another authority than the Architect, of the date fixed for such inspection. Inspections by the Architect shall be promptly made. If any such work should be covered up without approval or consent of the Architect, it must, if required by the Architect, be uncovered for examination at the Contractor's expense.

Re-examination of questioned work may be ordered by the Architect. If such work be found in accordance with the Contract, the Owner shall pay the cost of re-examination and replacement. If such work be found not in accordance with the Contract, through the fault of the Contractor, the Contractor shall pay such cost, unless he shall show that the defect in the work was caused by another contractor, and in that event the Owner shall pay such cost.

Art. 14.—Correction of Work Before Final Payment.—The Contractor shall promptly remove from the premises all materials condemned by the Architect as failing to conform to the Contract, whether incorporated in the work or not, and the Contractor shall promptly replace and re-execute his own work in accordance with the contract and without expense to the Owner and shall bear the expense of making good all work of other contractors destroyed or damaged by such removal or replacement.

If the Contractor does not remove such condemned work and materials within a reasonable time, fixed by written notice, the Owner may remove them and may store the material at the expense of the Contractor. If the Contractor does not pay the expense of such removal within five days thereafter, the Owner may, upon ten days' written notice, sell such materials at auction or at private sale and shall account for the net proceeds thereof, after deducting all the costs and expenses that should have been borne by the Contractor.

Art. 15.—Deductions for Uncorrected Work.—If in the opinion of the Architect it is not expedient to correct defective work or work not done in accordance with the Contract Documents, the Owner may deduct from the contract price the difference in value between the work as done and that called for by the Contract, the amount of which shall be determined in the first instance by the Architect.

Art. 16.—Correction of Work After Final Payment.—Neither the final certificate nor payment, nor any provision of the Contract Documents shall relieve the Contractor from responsibility for faulty materials or workmanship, which shall appear within a period of one year from the date of completion of the work, and he shall remedy any defects due thereto and pay for any damage to other work resulting therefrom which shall appear within such period of one year, but beyond that the Contractor shall not be liable. The Owner shall give notice of observed defects with reasonable promptness. All questions arising under this article shall be decided as provided in Articles 10 and 43 hereof.

Art. 17.—Protection of Work and Property.—The Contractor shall maintain continuously adequate protection of all his work from damage and shall protect the Owner's property from injury arising in connection with this Contract. He shall make good any such damage or injury, except such as may be directly due to errors in the Contract Documents. He shall protect adequately adjacent property as provided by law and the Contract Documents.

Art. 18.—Emergencies.—The Architect has authority to stop the progress of the work whenever in his opinion such stoppage may be necessary to ensure the proper execution of the work. In an emergency affecting or threatening the safety of life or of the structure or of adjoining property he has authority to make such changes and to order such work extra to the contract or otherwise as may in his opinion be necessary.

Art. 19.—Contractor's Liability Insurance.—The Contractor shall maintain such insurance as will protect him from claims under Workmen's Compensation Acts and from any other claims for damages for personal injury, including death, which may arise from his operations under this contract. Certificates of such insurance shall be filed with the Owner, if he so require, and shall be subject to his approval for adequacy of protection.

Art. 20.—Owner's Liability Insurance.—The Owner shall maintain such insurance as will protect him from any liability to the public to which he may be subject for personal injury including death which may be caused by the operations under the Contract Documents.

Art. 21.—Fire Insurance.—Unless otherwise specifically provided in the Contract Documents the Owner and the Contractor shall each protect his interest against loss or damages by fire, cyclone, earthquake, flood or other action of the elements pending full performance of the work by the Contractor and full payment therefor by the Owner. For the purpose of maintaining such insurance the Owner's interest at any time shall be held to be the sum of all payments which he shall have made to the Contractor on account of the work. For the same purpose the Contractor's interest shall be held to consist of any and all value under and appertaining to the work not above defined as Owner's interest. Loss or damage by such action of the elements shall not affect the rights and obligations of either party under the Contract Documents except that in such event the Contractor shall be entitled to a reasonable extension of time for the performance of the work and to be paid at the original contract price for all reconstruction necessitated by loss or damage covered by the insurance required to be carried by the Owner as aforesaid. Certificates of such insurance shall be exchanged between the Owner and the Contractor upon the request of either of them.

Art. 22.—Guaranty Bonds.—The Owner shall have the right to require the Contractor to furnish bond covering the faithful performance of the contract and the payment of all obligations arising thereunder, in such form as the Owner may prescribe and with such sureties as he may approve. If such bond is required by written instructions given previous to the receipt of bids, the premium shall be paid by the Contractor; if subsequent thereto, it shall be paid by the Owner.

Art. 23.—Cash Allowances.—The Contractor shall include in the contract sum all allowances named in the Contract Documents and shall cause the work so covered to be done by such contractors and for such sums as the Architect may direct, the contract sum being adjusted in conformity therewith. The Contractor declares that the contract sum includes such sums for expenses and profit on account of cash allowances as he deems proper. No demand for expenses or profit other than those included in the contract sum shall be allowed. The Contractor shall not be required to employ for any such work persons against whom he has a reasonable objection.

Art. 24.—Changes in the Work.—The Owner, or the Architect, without invalidating the contract, may make changes by altering, adding to, or deducting from the work, the contract sum being adjusted accordingly. All such work shall be executed under the conditions of the original contract except that any claim for extension or reduction of time caused thereby shall be adjusted at the time of ordering such change.

Except as provided in Article 18, no change shall be made unless in pursuance of a written order from the Owner or the Architect, and no claim for an addition to or deduction from the contract sum shall be valid unless so ordered.

The value of any such change shall be determined in one or more of the following ways:

(a) By estimate and acceptance in a lump sum.

(b) By unit prices agreed upon.

(c) By cost and percentage or by cost and a fixed fee.

(d) If none of the above methods is agreed upon, the Contractor, provided he receive an order as above, shall proceed with the work, no appeal to arbitration being allowed from such order to proceed.

In cases of additional work to be paid for under methods (c) or (d), the Contractor shall keep and present in such form as the Architect may direct, a correct account of the net cost of labor and materials, together with vouchers. In any case, the Architect shall certify to the amount, including a reasonable profit, due to the Contractor.

Pending final determination of value, payments on account of changes shall be made on the Architect's certificate.

Art. 25.—Claims for Extras.—If the Contractor claims that any instructions, by drawings or otherwise, involve extra cost under this contract, he shall give the Architect written notice thereof before proceeding to execute the work and, in any event, within three weeks of receiving such instructions, and the procedure shall then be as provided in Article 24. No such claim shall be valid unless so made.

Art. 26.—Applications for Payments.—The Contractor shall submit to the Architect an application for each payment and if required receipts or other vouchers showing his payments for labor and for material including material on the site but not then incorporated in the work and including also payments to sub-contractors as required by Article 42.

If payments are made on valuation of work done, such application shall be submitted at least ten days before each payment falls due and, if required, the Contractor shall before the first application, submit to the Arcitect a schedule of values of the various parts of the work, aggregating the total sum of the contract, divided so as to facilitate payments to subcontractors made out in such form and, if required, supported by such evidence as to its correctness, as the Architect may direct. This schedule, when approved by the Architect, shall be used as a basis for certificates of payments, unless it be found to be in error. In applying for payments, the Contractor shall submit a statement based upon this schedule and, if required, itemized in such form and supported by such evidence as the Architect may direct, showing his right to the payment claimed.

Art. 27.—Certificates and Payments.—If the Contractor has made application as above, the Architect shall, not later than the date when each payment falls due, issue to the Contractor a certificate for such amount as he decides properly to be due.

The payment to be made on substantial completion of the entire work shall only be made if the Contractor shall have given satisfactory evidence that no Mechanic's Lien other than his own exist in respect of the work. Upon such substantial completion of the work the Contractor shall notify the Architect in writing to that effect and within one week after receiving such notification the Architect shall prepare and deliver to the Contractor an itemized statement of any incomplete portions of the work with details of the values thereof and may deduct the value of such incomplete work from the amount payable to the Contractor upon substantial completion of the work, and with such itemized statement he shall issue to the Contractor his certificate for the amount then payable which shall be the entire balance payable under the contract less the value of incomplete work as shown by the Architect's itemized statement.

No certificate other than the final certificate issued, nor payment made to the Contractor, nor partial or entire use or occupancy of the work by the Owner shall be an acceptance of any work or material not in accordance with this contract. The issuance of the final certificate and the acceptance thereof by the Owner shall constitute a waiver of all claims by the Owner otherwise than under Articles 16 and 28 of these conditions, and the acceptance of such final certificate by the Contractor shall constitute a waiver by him, of all claims except those previously made and still unsettled.

Should the Owner fail to pay the sum named in any certificate of the Architect or in any award by arbitration, upon demand when due, the Contractor shall receive, in addition to the sum named in the certificate, interest thereon at the legal rate in force at the place of building.

Art. 28.—Liens.—Neither the final payment nor any part of the retained percentage shall become due until the Contractor, if required, shall deliver to the Owner a complete release of all liens arising out of this contract, or receipts in full in lieu thereof and, if required in either case, an affidavit that so far as he has knowledge or information the releases and receipts include all the labor and materials for which a lien could be filed; but the Contractor may, if any sub-contractor refuses to furnish a release or receipt in full, furnish a bond satisfactory to the Owner, to indemnify him against any claim by lien or otherwise. If any lien or claim remain unsatisfied after all payments are made, the Contractor shall refund to the Owner all moneys that the latter may be compelled to pay in discharging such lien or claim, including all costs and a reasonable attorney's fee.

Art. 29.—Permits, Notices, Laws and Rules.—The Contractor shall obtain for the Owner and at the Owner's expense all necessary permits or licenses required for the execution of the work (but this shall not include the obtaining of permanent easements) give all necessary notices, pay at the expense of the Owner all fees required by law and comply with all laws, ordinances, rules and regulations relating to the work and to the preservation of the public health and safety, and if the specifications and drawings are at variance therewith he shall notify the Architect in writing of the effect of such compliance upon the contract price.

Art. 30.—Patents Fees.—The Contractor shall pay all royalties and license fees and shall save the Owner harmless from loss on account of suits or claims which may arise by reason of the work for infringement of patents in force at the time of the signing of the Contract Documents.

Art. 31.—Use of Premises.—The Contractor shall confine his apparatus, the storage of materials and the operations of his workmen to limits indicated by law, ordinances, permits or directions of the Architect and shall not unreasonably encumber the premises with his materials.

The Contractor shall not load or permit any part of the structure to be loaded with a weight that will endanger its safety.

The Contractor shall enforce the Architect's instructions regarding signs, advertisements, fires and smoking.

Art. 32.—Cleaning up.—The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish caused by his employees or work, and at the completion of the work he shall remove all his rubbish from and about the building and all his tools, scaffolding and surplus materials and shall leave his work "broom clean" or its equivalent, unless more exactly specified. In case of dispute the Owner may remove the rubbish and charge the cost to the several contractors as the Architect shall determine to be just.

Art. 33.—Cutting, Patching and Digging.—The Contractor shall do all cutting, fitting or patching of his work that may be required to make its several parts come together properly and fit it to receive or be received by work of other contractors shown upon, or reasonably implied by, the drawings and specifications for the completed structure and he shall make good after them, as the Architect may direct.

Any cost caused by ill-timed work shall be borne by the party responsible therefor.

The Contractor shall not endanger any work by cutting, digging or otherwise and shall not cut or alter the work of any other Contractor save with the consent of the Architect.

Art. 34.—Delays.—If the Contractor be delayed in the completion of the work by any act or neglect of the Owner or Architect or of any employee of either, or by any other contractor employed by the Owner or by changes ordered in the work, or by strikes, lockouts, fire, unusual delay by common carriers, or unavoidable casualties or by any other cause of any kind whatsoever beyond the Contractor's control or by any cause within the Contractor's control which the Architect shall decide as justifying the delay, then the time of completion shall be extended for such reasonable time as the Architect may decide.

No such extension shall be made for delay occurring more than seven days before claim therefor is made in writing to the Architect. Provided, however, that in the case of a continuing cause of delay, only one claim shall be necessary.

If no schedule is made under Article 3, no claim for delay shall be allowed on account of failure to furnish drawings until two weeks after demand for such drawings and not then unless such claim be reasonable.

The Architect shall not have power, except by written notice to the Contractor, to stop or delay any part of the main contract work pending decisions or proposed changes by himself or by the Owner.

Art. 35.—Owner's Right To Do Work.—If the Contractor should neglect to prosecute the work properly or fail to perform any provision of this contract, the Owner, after three days' written notice to the Contractor, may, without prejudice to any other remedy he may have, make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor; provided, however, that the Architect shall approve both such action and the amount charged to the Contractor.

Art. 36.—Owner's Right To Terminate Contract.—If the Contractor should be adjudged a bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of his insolvency or if he should, except in cases recited in Article 34, refuse or fail to supply enough properly skilled workmen or proper materials after having received fourteen days' notice in writing from the Architect to supply additional workmen or materials, or if he should fail to make prompt payment to sub-contractors or for material or labor, or persistently disregard laws, ordinances or the instructions of the Architect, or otherwise be guilty of a substantial violation of the provision of the contract, then the Owner, upon the certificate of the Architect that sufficient cause exists to justify such action, may, without prejudice to any other right or remedy by giving the Contractor written notice, terminate the employment of the Contractor and take possession of the premises and of all materials, tools and appliances thereon and finish the work by whatever method he may deem expedient, but without undue delay. In such case the Contractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the contract price shall exceed the expense of finishing the work, including compensation to the Architect for his additional services, such excess shall be paid by the

Contractor. If such expense shall exceed such unpaid balance, the Contractor shall pay the difference to the Owner. The expense incurred by the Owner as herein provided, and the damage incurred through the Contractor's default, shall be certified by the Architect.

Art. 37.—Contractor's Right To Stop Work Or Terminate Contract.—If the work should be stopped under an order of any court, or other public authority, through no act or fault of the Contractor or of any one employed by him, or if the Owner should fail to pay to the Contractor, within seven days of its maturity and presentation, any sum certified by the Architect or awarded by arbitrators, then the Contractor may, upon three days' written notice to the Owner and the Architect, stop work or terminate this contract and recover from the Owner payments for all work executed and any loss sustained upon any plant or material and reasonable profit and damages.

Art. 38.—Mutual Responsibility of Contractors.—Should the Contractor suffer damage by any act, neglect or default or any other contractor employed by the Owner upon the work, the Owner shall be responsible therefor. The Contractor shall make his claim in writing against the Owner through the Architect at his office or to the Architect's representative upon the work within forty-eight hours after the happening of the event causing such damage to the Contractor, and the Architect shall adjudicate upon all claims made against the Owner under this section and shall certify the same to the Owner.

Art. 39.—Separate Contracts.—The Owner reserves the right to let other contracts in connection with the work and the Contractor shall connect properly and co-ordinate his work with that of other contractors. If any part of the Contractor's work depends for its proper execution or results upon the work of another contractor, the Contractor shall report promptly to the Architect any defects in the work of such other contractor as may interfere with the proper execution of the Contractor's work. Should the Contractor fail so to inspect and report he shall have no claim against the Owner by reason of the defective or unfinished work of any other contractor except as to latent defects not reasonably noticeable at the time of the commencement of the Contractor's work.

Art. 40.—Assignment.—Neither party to the Contract shall assign the contract without the written consent of the other.

Art. 41.—Sub-Contracts.—The Contractor shall, as soon as practicable after the signature of the contract, notify the Architect in writing of the names of sub-contractors proposed for the principal parts of the work and for such others as the Architect may direct and shall not employ any that the Architect may within a reasonable time object to as incompetent or unfit.

If the Contractor has submitted before signing the contract a list of sub-contractors and the change of any name on such list is required or permitted after signature of agreement, the contract price shall be increased or diminished by the difference between the two bids.

The Architect shall, on request, furnish to any sub-contractor, wherever practicable, evidence of the amounts certified to on his account.

The Contractor agrees that he is as fully responsible to the Owner for the acts and omissions of his sub-contractors and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

Nothing contained in the Contract Documents shall create any contractual relation between any sub-contractor and the Owner.

Art. 42.—Relations of Contractor and Sub-contractor.—The Contractor agrees to bind every sub-contractor by the terms of the General Conditions, Drawings and Specifications, as far as applicable to his work.

Art. 43.—Arbitration.—Subject to the provisions of Article 10, all questions in dispute under this Contract shall be submitted to arbitration at the choice of either party to the dispute. The Contractor agrees to push the work vigorously during arbitration proceedings. The general procedure shall conform to the laws of the province in which the work is to be erected.

Loose Leaf Thew Binder

The Thew Shovel Company, Lorain, Ohio, are distributing a loose-leaf binder containing all their catalogue sections to date. Additional sections will be supplied as published. Our readers will recall that the Thew catalogue is issued in sections; for example, bulletin 111 deals with Type O Steam Shovel; bulletin 111 X with Type O Continuous Tread; bulletin 201 with Type O Electric Shovel; bulletin 601 with Type O Gasoline Shovel; bulletin 501 with Type O Crane, Steam, Gasoline, Electric; bulletin 112 with Type OO Steam Shovel; bulletin 202 with Type OO Electric Shovel; bulletin 602 with Type OO Gasoline Shovel; bulletin 113 with Type A 1 Steam Shovel; they also publish a bulletin on lubrication

Report Completed on Floor and Partition Tests

A report on Interior Building Construction, consisting of metal lath and gypsum plaster on wood supports, has been completed and is now ready for printing and distribution. The investigation described in the report was inaugurated two or three years ago and the work was carried on at the Underwriters' Laboratories in Chicago as a joint project by the National Lumber Manufacturers' Association and the Associated Metal Lath Manufacturers. The object of the tests was to develop a construction for floors and partitions which would offer a maximum resistance to the spread of fire. It was the belief of those engaged in this work that utilization of suitable, readily available materials and methods of design was not only possible but entirely practicable, and this without material additional cost of building and without the need for educating the public to live or work under new or strange conditions.

The printed report, which contains something over one hundred pages, sets forth in detail all of the facts that were developed and contains a number of recommendations to the Fire Council of the Underwriters' Laboratories asking that this type of construction be given a one-hour rating. The recommendations are based upon the standard requirements of the Underwriters' Laboratories and the rating should lead to the consideration of this type of construction when economic considerations do not require or justify so-called "fire-resistive" construction throughout.

The Trend of Highway Transport Education

A Paper Presented at the Conference on Highway Engineering and Highway Transport Education by A. H. Blanchard, Professor of Highway Engineering, University of Michigan

What is included in highway transport education? I conceive that highway transport education should cover the fundamentals of the science, art, economics and business of the transportation of passengers and commodities over highways. Courses in this field will be taken by men looking forward to the profession of highway transport engineering, the motor vehicle industry, and the businesses of traffic management and highway transport.

In the opinion of some, highway transport may not be considered as belonging to the field of technical training and education. On sober thought, however, it will be seen that this branch of knowledge comes well within the classic definition of engineering embodied in the Royal Charter of the Institution of Civil Engineers of Great Britain, which in part, is as follows: "The art of directing the great sources of power in nature for the use and convenience of man as the means of production and of traffic in states both for external and internal trade."

From the standpoint of highway transport business, courses in this field will be taken by men who desire to efficiently equip themselves for the positions of business administrators, dealers, salesmen and advertisers in the motor vehicle industry, and executives, operators, traffic managers, motor truck fleet managers, and dispatchers in the commercial field of highway transport, and in the closely related fields of railway and waterway transport.

The Demand for Highway Transport Engineers

What is the demand for highway transport engineers and men equipped for highway transport business? In May, 1920, the First National Conference on Highway Engineering and Highway Transport Education held in Washington, D. C., unanimously adopted the conclusion that 4,000 men should be trained in highway transport each year in universities for the positions heretofore enumerated. Many have misinterpreted the meaning of this conclusion. Emphasis should be placed on the words "SHOULD BE TRAINED." The representative committee framing this conclusion had in mind the economic and efficient utilization of highway transport in the transportation system of the United States. They did not say that there was an immediate call for 4,000 trained men each year but they did imply that the country would be benefited by having 4,000 men trained each year and their services utilized in the field of highway transport.

What is the present situation in regard to the demand for highway transport engineers and men trained in the business of highway transport? While it is true that the University of Michigan, which first instituted courses in highway transport and is in the heart of the motor vehicle industry, has no difficulty in placing its men in the highway transport field, the number of well paid positions available in this field at the present time is comparatively small. Why does this condition exist? The answer is simple. The potential users of men trained in highway transport are not educated to the value of the service of such men.

Many highway departments are not properly designing the highways for even immediate future traffic because their personnel does not include men who have had a proper training in highway transport to have a vision and adequate background which will enable them to diagnose the probable development of traffic on a given highway, or in other words, to make the prerequisite of economic highway design, a highway transport survey, which embodies all investigations in the field and office which are necessary to efficiently estimate the probable amount, character and effects of the future traffic which will use a given highway during the lives of its several component parts.

The establishment of a sound highway transport business is based on the results of an exhaustive transport survey. Why should not the same policy be followed when the economic investment of millions of dollars in highway improvements is at stake?

A Highway Transport Division

In order that highway transport surveys should be properly conducted and adequate provision be made for the economic design, construction and maintenance of highways, each highway department should create a highway transport division. The duties of this division would be to deal with all matters pertaining to traffic and transportation which affect the economic design and maintenance of highways and their efficient use by pedestrians and all classes of vehicles. One of the most important functions of such a division would be to make highway transport surveys as preliminary to the design and redesign of highways, the determination of efficient methods of maintenance, and the formulation of recommendations pertaining to efficient traffic and transport regulations.

Men assigned to a highway transport division should be experienced highway engineers who have or are rapidly acquiring a knowledge of the following subjects: Highway transport economics, legislation, surveys and methods; highway transport management, including delivery systems, scheduling and routing; traffic regulations; interrelationship of highway, railway and waterway transport; port, terminal and warehouse facilities; and the fundamentals of the mechanism and operation of automobiles, motor trucks, tractors and trailers.

In order to secure and retain the services of engineers qualified to occupy responsible positions in a highway transport division, it will be necessary for highway departments to pay salaries ranging from $3,600 to $10,000. Not only will the economic law of demand and supply in the highway engineering field necessitate the payment of proper salaries to engineers trained and experienced in highway transport, but highway departments will be forced to compete with the commercial demand for the services of such men.

Motor truck manufacturers' organizations are in a chaotic condition from the standpoint of the proper utilization of men trained in highway transport.

Why? In general, they have followed in the obliterated footsteps of companies manufacturing highway machinery and materials. The latter companies originally established departments which were advertised to give unbiased consulting service to their customers. Motor truck companies established a few years ago highway transport engineering departments and advertised to make a complete highway transport survey covering the requirements of a prospective user of motor trucks and to give unbiased advice pertaining to the purchase of equipment. What was the result? In the first place, it was found impracticable to divorce unbiased opinion from the commercial interests of the organization represented and soon prospective customers began to realize this self-evident fact. Second, disastrous conflict arose between the highway transport engineering department and the sales organization, a natural result to anyone familiar with the interrelationship existing between the activities of such departments. What was the final outcome in the case of companies manufacturing highway materials and machinery? The natural logical conclusion was reached that the sales organization should contain men trained in the fundamentals of highway engineering practice and the efficient use of the machinery or materials manufactured by a given company and that advice should be restricted to the efficient and economic utilization of the machinery or materials manufactured. The results have been beneficial not only from the standpoint of the commercial organizations concerned but also from the standpoint of the general highway engineering profession and the public, which ultimately is benefited by increased efficiency. All are familiar with the efficient services rendered along these lines by such commercial organizations as the Asphalt Association, the Barrett Company, the Granite Block Manufacturers' Association, the Jennison-Wright Company, the National Paving Brick Manufacturers' Association, the Portland Cement Association, the Texas Company and many others. I predict that in the near future the motor truck manufacturers of this country will see the light and follow in the footsteps of the closely related companies who have already passed through the transition stage. Concretely stated, the sales organizations of motor truck, tractor and trailer companies should be composed of men trained in the fundamentals of highway transport and the efficient use of the equipment manufactured by the company which they represent.

Failures of Highway Transport Companies

Failures of highway transport enterprises are occurring every day due to a lack of knowledge of the fundamentals of the economics, science and art of highway transport. It is reported that ninety per cent of all highway companies doing business with New York City as a center fail within three years after entering this field. While fifty per cent may fail due to cut-throat competition by fly-by-night companies, it is comparatively estimated that at least fifty per cent fail because of lack of knowledge of the A B C's of efficient highway transport business methods, cost accounting, management, and the operation and maintenance of equipment. There must be brought to the attention of groups of business men or capitalists, operators and prospective operators of highway transport, the necessity of having connected with their operating organizations men who are thoroughly trained in the methods of highway transport, the interrelationship of highway, railway and waterway transport, cost and record systems and the principles of highway transport management, together, of course, with a knowledge of the mechanism, operation and maintenance of motor trucks, tractors and trailers.

We find a satisfactory status relative to the development of highway transport education in many of the universities. In some institutions, the logical development occurs by the men having charge of highway engineering courses giving courses in the related field of highway transport. In other institutions, such courses are offered by the department of economics or business administration. If these departments are to efficiently teach highway transport, the instructors must have a knowledge of the fundamentals of the economics and science of highway engineering and practical highway transport. It is expected that notable developments will take place along these lines especially when authoritative texts are available. We have a development in the main of undergraduate instruction in the fundamentals of highway transport. In this connection, allow me to strongly emphasize a recommendation which I have made at the University of Michigan that all engineers should be required to take, as a part of their curricula, a fundamental course in "transportation" which would cover the economics of the utilization and operation of highway, railway and waterway transport.

Education in Highway Transport Work

Naturally, developments in the graduate field have been slow due, first to a lack of demand by students for such courses; second, because there are few instructors who feel capable of giving graduate instruction in this field; and third, due to a lack of the necessary financial support by institutional administrators.

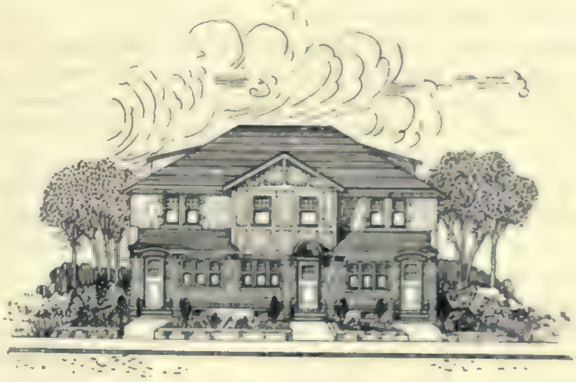
As soon as the demand from potential users develops, it will be necessary to materially speed up the training of mature men as well as college students in the fundamentals of highway transport. It is my belief that the graduate short period course offers the most efficient method of training mature men who may be connected with motor truck or trailer manufacturers' promotion and sales organizations; traffic departments of plants, factories, wholesale and retail stores, steam and electric railroads, and waterway transportation companies; highway transport enterprises; and state, provincial, county or municipal highway departments. Such courses in the field of highway engineering and highway transport are developing rapidly at the university which I have the honor to represent. Eighteen of these courses are given in periods of two weeks each during the months from December to March inclusive. Each course consists of thirty lectures, or the equivalent thereof, and counts as two hours credit towards the total of twenty-four hours required for the master's degree. Persons of mature age, who do not hold collegiate or technical degrees, may register for these courses as special students, not candidates for a degree. In the first year, 1919-1920, when such courses were offered at the University of Michigan, the attendance was twenty-nine. In 1920-1921, the attendance increased to forty-five, while in 1921-1922, ninety-four men were registered in these courses, the average age of the men being twenty-seven years, ranging from twenty-two to fifty-four years. They came from all over the United States, and some from foreign countries.

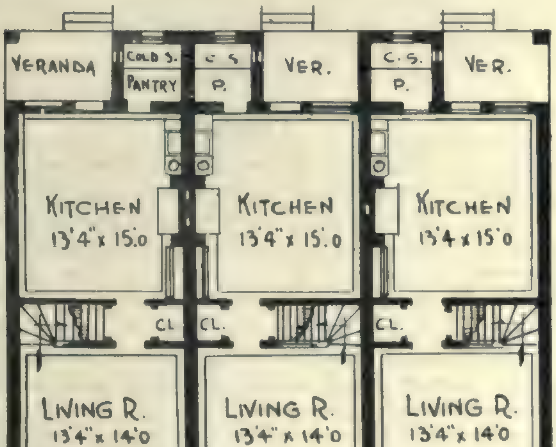
The Contract Record's

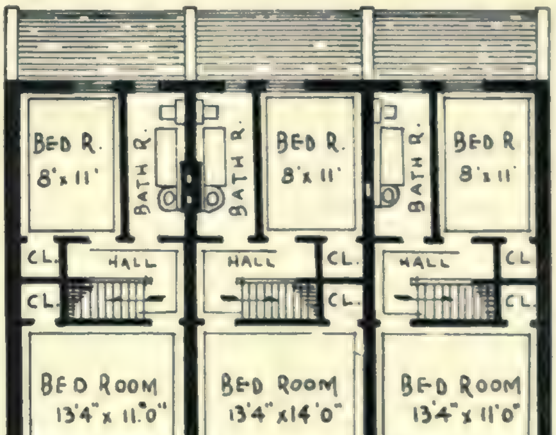
Weekly House Suggestion No. 44

The accompanying illustrations show a type of house, containing three residences that was estimated to be built at Montreal at the remarkably low price of $8,500. The plans and specifications for this house were prepared by Mr. J. A. S. Houle, architect of Montreal.

Although this house appears small, the available space and its cost makes it compare more favorably with apartments of four and five rooms as far as comfort and rent are concerned. All rooms are large and well lighted and ventilated directly from the outside through extra large windows. The house measures 44 ft. in frontage by 35 ft. in depth, with a 6 ft. extension at the back for the verandahs. It is built 15 ft. back from the street line. The outer walls of the first storey are of brick and wood to the second floor and stucco above. Each residence contains four rooms, two downstairs and two upstairs, with hall and passageway. To the kitchen, which is extra large, 13' 4" x 15' 0", is connected a 5' x 4' cold room and pantry. A cloakroom is located alongside the passage connecting the living room to the kitchen. Each of the two rooms of the upper floor is provided with a wardrobe. There is also a 2' x 3' linen closet. The front room of the middle residence is larger in size than those on each side on account of the vertical extension of the lower wall. The floors downstairs are of hardwood. The basement extends under the entire area of each residence. The foundations are concrete and the roof is finished with asphalt shingles.







Mainly Constructional

East and West—From Coast to Coast

The Huntsville Brick Works, operated by Stevens Bros., well known brick manufacturers, has recently re-opened its plant at Huntsville, Ont., and will manufacture common red brick chiefly.

Special courses in road construction and maintenance will be established at the Montreal Technical School and the Quebec Technical School this winter, states a recent announcement. Engineers of the provincial department of highways will be in charge of the classes and the course will include several technical lectures by experts on road construction and maintenance.

British Empire Steel Corporation is again operating profitably and is furnishing practically full time employment to more than 23,000 men.

A recent report states that the British Columbia Electric Company, in addition to extensive improvements to present power plant holdings on Stave River, are planning the construction of a new $10,000,000 power plant farther down the river from the site of the present plant. It is estimated this new development will produce 100,000 h.p.

The following motion was presented by the Finance Committee of Kitchener to the local council, at a recent meeting of the latter body: "That in order to provide the council with complete information in regard to a city plan the engineer procure from Mr. Leavitt, New York, his terms for undertaking such work along the same lines as offered by Mr. Adams, including reference to other cities, Canadian preferred, where he has satisfactorily completed such plans, also that similar information be procured from N; Cauchon, Ottawa, and the city planning department of the government."

Two examinations for the degree of Associate of the Royal Institute of British Architects are to be held December 11th at the Engineers' Club and headquarters of the Ontario Association of Architects, 96 King St., West. One of the examinations is for students taking the ordinary exam. which involves study of a course for about five years and calls for the entrant to be over 21 years of age and a British subject. The second examination held at the same time is for students who, through the war, were interrupted in their course of study for architects, or intended to take up the study, but were prevented doing so by reason of enlisting. This examination involves a shorter course of study.

The opening of the Brantford-Hamilton highway is to take place today, November 15. Mr. F. C. Biggs, Minister of Public Works, Ontario, will officiate at the ceremony, which will be followed by a motor drive to Brantford, the party returning in the evening to Hamilton where they will be the guests of the Hamilton Chamber of Commerce at a dinner in the Royal Connaught hotel. Hon. J. L. Perron, Minister of Highways, Quebec, will be present at the ceremony.

In addition to the water works, sewers and roads by-laws, totalling $300,000, the ratepayers at Vancouver may this year be asked to authorize the expenditure of $65,000, fire protection for Stanley Park; $25,000 for school purposes; $250,000 towards new city hall and $250,000 for the purchase of the Seymour Creek watershed, bringing the total close to a million dollars.

The town of Oshawa, Ont., is establishing a new building record this year, permits issued during the month of October having totalled $308,450. This figure is just $8,000 short of the total value of building permits issued all last year.

Rosedale Annex, a new subdivision north of Toronto, has applied to the city for a water supply of 60,000 gallons and in view of the advantages to be derived from the development of this section, the city has granted this request. The new section will undertake the erection of a $300,000 bridge across the Don Valley entirely at their own expense, which will connect Rosedale Annex and Rosedale proper.

Hon. J. L. Perron, Minister of Roads in the Quebec Government; J. L. Boulanger, Deputy Minister of Highways, and Messrs. J. A. Duchastel and George A. McNamee, members of the Executive Committee of the Canadian Good Roads Association, were in Toronto yesterday to attend a meeting of the Executive Committee. They will tour some of Ontario's new highways as the guests of Hon. F. C. Biggs, Minister of Public Works in the Ontario Government, today and tomorrow.

Plans for launching a campaign in connection with the proposed erection of a million-dollar Protestant hospital at Hamilton were discussed at a meeting of the Irish Protestant Benevolent Society. It was stated that, while the project has not assumed any tangible form as yet, it was favorably received by those organizations to which it had been submitted.

A recent report from Vancouver states that the entire foundation and deck of the west frontage of the new Ballantyne pier are completed and the east side construction is progressing rapidly. Before the end of the year the entire foundation and decking of the pier will be completed and all labor will then be concentrated on the concrete sheds. There are about 500 workmen, working day and night in three shifts on this pier, which, when completed, will be one of the finest structures of its kind in the world.

The Sheet Metal section of the Builders' Exchange, at Toronto, and the local Sheet Metal Workers' Union have reached an agreement at 80 cents an hour for this type of labor until April, 1924.

The city council at Vancouver took a 75-day option on the Tower building, in that city recently, which was offered at $200,000. It is said that the building cost half a million. The intention is to use it as a city hall. A by-law will have to be submitted to the ratepayers.

Personal

The partnership of Bains & Grummett, dealers in builders' supplies, coal, etc., of Semans, Sask., has been dissolved.

Mr. E. M. Proctor, of the Toronto engineering firm of James, Proctor & Redfern, recently made a business trip to Manitoulin Island for the purpose of advising the local authorities on a power development proposition at Kagawong Falls.

Mr. H. P. Hevenor, until recently a member of the engineering firm of Engel & Hevenor, Inc., of New York, has joined the staff of Dwight P. Robinson & Co., of Montreal and New York, in the capacity of consulting engineer. Mr. Hevenor has been connected with several large track construction projects throughout the United States.

Obituary

Mr. Wm. Dube, superintendent of the road department at Grand'mere, P. Q., was instantly killed a few days ago, when a motor truck in which he was riding was struck by a C. N. R. train at a railway crossing between St. George and Grand'mere. The driver of the truck was also killed.

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL	119 Board of Trade Bldg.
WINNIPEG	302 Travellers' Bldg.
VANCOUVER	Winch Building
NEW YORK	296 Broadway
CHICAGO	14 West Washington St.
LONDON, ENG.	16 Regent Street S.W.

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Canada, Great Britain and British Possessions $3.00. U. S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 **Toronto, November 22, 1922** **No. 47**

Ontario's Road Program is Advanced Another Stage

The Ontario Department of Public Highways has announced that its program for this year so far as provincial roads are concerned has been completed. According to a statistical report, over 300 miles of pavement of one sort or another have been finished in addition to a greater mileage of grading and the erection of culverts to the number of 1,300. Ten million dollars is the approximate expenditure that has been involved, a proportion of this being collectable from the Dominion government under the Federal aid scheme. Of course, this refers only to the construction of so-called provincial highways. In addition to the ten millions thus expended, the counties and townships throughout Ontario have been this year heavy spenders. Without having any definite figures at hand yet, it is probable that the gross amount spent on road building in Ontario this year will mount up to over $25,000,000. The provincial government is, of course, responsible for the major part of this, for, in addition to the amount involved in the construction of provincial roads, it heavily subsidizes the counties and townships.

Departmental figures show the following summary of work as completed this year: Bituminous concrete, 44.9 miles; portland cement concrete, 43.25 miles; bituminous macadam, 11.25 miles; waterbound macadam, 107.4 miles; macadam base course, 138 miles; grading, 487 miles; concrete culverts, 1,300; bridges, 23; railway crossing subways, 2.

This work, the highways department states, has been accomplished as the result of a season which has been most propitious for furthering the province's good roads' scheme. The weather, it is pointed out, has been most favorable, supplies of materials have been more regular and labor has been most efficient.

The locations of the department's principal work have been in the Niagara peninsula and in Western Ontario. As a consequence of its activities in these regions, the Hamilton to Brantford and Hamilton to Queenston roads have been completed with the result that a paved surface now exists from Hamilton to Niagara Falls. London and St. Thomas and Welland and Niagara Falls have been linked up while work has also radiated from the cities of Chatham, Windsor, Ottawa, Peterboro and Toronto.

It is thus evident that the 1,800-mile program of the Ontario government is now several stages further advanced. When the scheme was first announced, it was regarded as a very ambitious venture, but the problem has been so thoroughly and satisfactorily attacked that one can now see the completion of the whole program in sight. Ontario will then have highways second to none on the continent, not only in their type of construction, but also in the way in which they link up every portion of the province and serve the people for whom they were built.

The Importance of Water Purification

The importance of water purification is well emphasized in an editorial comment which appears in "Engineering and Contracting." It is pointed out that increased demands for water for use by cities, and the lessened opportunities for securing uncontaminated supplies, are vastly increasing the use of purification systems. Easily available supplies of pure water have practically ceased to exist—either because they have long since been appropriated or because habitations and industry have expanded over watershed areas that once were clean. It is stated further:

"Cities that formerly had abundant supplies of good water have increased in population beyond expectation at the same time that per capita consumption has increased, until the old supplies have become entirely inadequate, and the cities have been forced to augment them with water brought from a great distance or with water purified from what was once considered a wholly unsuitable source.

"In the public mind there still lingers the idea that pure water can only be had from a pure source, and so strong is this idea that it sometimes leads to the expending of needlessly large sums in bringing water from a distance, when much cheaper and equally wholesome supplies could be had by taking water near at hand and purifying it by approved modern methods.

"More instances of this sort should not occur, for the waste of public funds is as inexcusable as is the waste of private. The makers of purification apparatus and supplies may properly plead the cause whenever the issue arises, but they are not the ones whose arguments are likely to prove most effective.

"Engineers and engineering societies should harp before the public on the fact that by proper treatment an admittedly contaminated supply may be rendered thoroughly suitable for domestic consumption, and may, in fact, be much purer than a vastly more expensive supply brought from a distance without purification."

Peterboro Engineers Meet

Third Reunion of the Local Branch of the E. I. C.—Dean Mitchell Outlines Opportunities for the Engineer

To the Peterboro branch of the Engineering Institute of Canada at their third annual re-union and dinner, which was held in the Empress Hotel on November 14th, General C. H. Mitchell, Dean of the Faculty of Applied Science, University of Toronto, gave the challenge of the manifold opportunity for public service in solving some of the urgent problems of today by achievements comparable with those great engineering inventions and developments that are the marvel and the pride of the present age.

Mr. R. A. Ross of Montreal, who also spoke suggested that engineers should push back their horizons beyond purely technical limits to include such work as is generally indicated by that of Herbert Hoover. Mr. Ross intimated that such an expansion was becoming imperative as a result of the large number of men who were graduating from the engineering faculties of the universities. If they had "to bludgeon their way into these jobs," Mr. Ross believed that engineers should do so for the reason that they were specially qualified for them.

After a dinner and the usual toast list Gen. Mitchell addressed the gathering remarking that Peterboro was a centre of engineering activity in Ontario. It had produced many of the men whose names were associated with some of Canada's greatest projects, from Sanford Fleming down to the men of our day, such as Ross, Grant and others. After illustrating the progress that had been made in engineering by contrasting the old G.T.R. locomotives with the "moguls" now in use, General Mitchell said that in railroad management alone there were greater problems confronting the engineers of to-day than most persons imagined. The breaking of rails at crossings and "frog" points, the prevention of the ends of rails from sinking into the earth, the "strings" used as rail fasteners, the problem of paint used for structural steel, the question of water supply, which in Ontario is different from that in Manitoba, and that of Manitoba from Saskatchewan, these were some of the difficulties that were worrying railway managements.

"It all sounds simple," said General Mitchell, "but I was talking a few days ago with a high official of Canada's National Railways, who was wringing his hands over some of these problems. How is the Engineering Institute of Canada going to be a factor in solving these problems?"

General Mitchell illustrated his point by a story of three stonemasons who were separately asked what they were doing. The first of them replied that he was cutting stone; the second said that he was working for wages; and the third answered that he was helping to build a cathedral. "Let us feel and think as if we were working with the spirit and the object of the stonemason, who said he was helping to erect a cathedral," was his counsel.

A Vast Array of Problems

General Mitchell declared that if engineers did not attack and solve the exigent problems of to-day some one else would, business men, financiers or others. He cited fifteen of the difficulties that are now demanding a solution. Among them were the following: the economic organization and operation of the national railways; the economic electrification of railways now operating by steam; the building of new electric railways; the development of permanent highways systems, municipal, provincial and Dominion; long distance electric power transmission; the delivery of cheap electric power to farming communities; the operation of hydro-electric power plants in cold climates, as in the northern parts of this country; the recovery of minerals from low grade ores, and the present waste at our mines; electric smelting; the continued research and reconnaissance of our natural resources; what more can we learn of oil deposits in the northwest; of copper and gold in Saskatchewan and Alberta and Labrador; the construction and surfacing of highways; development of cheap motor trucks; a substitute motor fuel for gasoline; the development of apparatus for electric heating; the production of nitrogen from the air for the refertilization of Canada's western prairies.

General Mitchell said that these were problems for Canadian engineers to cope with, to keep them thinking and working. It was a national duty to endeavor to secure their solution, "and in due course we will get our reward," he concluded.

Montreal Builders' Exchange Activities

At a meeting of the board of directors of the Montreal Builders' Exchange on November 2, the president, Mr. K. D. Church, reported the result of an interview he had with Hon. Athanase David, provincial secretary, with regard to technical training for builders' mechanics. He stated that the net result of their visit was that the provincial secretary had promised that the Builders' Exchange should be invited to nominate two members to the Board of the Montreal Technical School, with a joint committee to formulate a scheme of study spread over a period of years for students of the various trades concerned in the building industry.

Discussion took place regarding representation of the Builders' Exchange on the board of directors of the Montreal Industrial Exhibition Association. Messrs. A. Plamondon and J. D. Johnson were authorized to use all proper measures to ensure that the Exchange should be adequately represented on this directorate.

It was decided that some general rule must be formulated, applicable to all trade sections, which were at the present time loosely associated with the Builders' Exchange, and a committee was appointed to consider this matter and report at the next meeting of the board as follows. H. Vincent, convener; A. E. Fryer, J. E. Walsh, and the secretary.

A communication was received from E. Dussard, of Dussard, Joly & Mougeon, suggesting that he be permitted to address the board at an early date with regard to official tests that might be applied to ceramic and other tiles. It was agreed that Mr. Dussard be heard at a general meeting of the Builders' Exchange, to be held in December.

Paint Protection for Steel Structures

A Practical Consideration of the Effectiveness of Paint as a Guarantee Against the Deterioration of Steel—The Essential Features of Good Paints and How They Should be Applied

By JOHN GRIEVE, A.M.E.I.C.
General Manager of Sales, Dominion Paint Works Ltd., Montreal

Paper read before the Montreal Branch of the Engineering Institute of Canada

Steel is the backbone of all structural design. The base on which engineering stands, in its relation to industrial development as an indispensable profession, is the manipulation of steel to its various uses. Every such development is dependent for success upon the service of the materials used in the design, their efficient distribution and the low maintenance costs due either to operation or depreciation.

The importance of arresting corrosion is admitted by engineers as it is known that steel will decay, if natural agencies are allowed to act on it, more rapidly than any other material used in construction. The transactions of almost every engineering society include papers on this subject and all kinds of theories have been advanced and suggestions submitted, but the subject has not yet attained the attention which its importance demands.

The following facts have militated against the proper consideration of corrosion: Practically the whole development of steel construction has occurred during the past fifty years, while the electro-chemical explanation of corrosion has been advanced, made the basis of tests and been generally accepted only within the past twenty years. It is evident, therefore, that for about thirty years the whole subject of corrosion was indefinite in the minds of many and few sound methods were advanced to combat it.

The Test of Plant Protection

When one considers that practical exposure tests of selected paints, require from three to four years for preliminary investigations before the qualities of each film can be determined, and thereafter from six to ten years to obtain the comparative results for service efficiency of the combined films, one can readily appreciate that only within the past decade have the anti-corrosive merits of some paint ingredients been truly appreciated.

It is necessary in the manufacture of paints to test chemically, pigments, gums and oils, prior to their incorporation in the paint, to insure freedom from undesirable impurities. In the physical laboratory also, many preliminary tests can be made to ascertain if a film has the desired qualities. But just as accelerated physical laboratory tests do not indicate the action which takes place gradually over an extended period between pigments and vehicle under exposure, so chemical analysis, after the paint is manufactured, does not indicate—except perhaps in elementary paints—the quality of ingredients, skill of compounding or service value of the paint.

Authorities have recognized for a long time that by ageing, in some cases for several years, oils, varnishes and mixtures of these with pigments, very much enhanced service value is obtained for the product. Chemical laboratory analysis, even in conjunction with accelerated physical tests, does not indicate or take into consideration this ageing of materials. Therefore, between paints of similar analysis there is no assurance of equal service value. The only true tests are those where paints are subjected to service exposure tests under conditions to which the paint will be subjected. These necessarily involve time.

Importance of Exposure Tests

The importance of actual exposure tests and the doubtful value of accelerated laboratory tests is mentioned by all authorities who have had an opportunity to compare results. A. S. Cushman and H. A. Gardner in their study of "Corrosion and Preservation of Iron and Steel" emphasize this point as follows: "The results of the acceleration tests may be taken as fairly good evidence of how the paint will work in practice but a series of practical exposure tests should also be started so that definite knowledge can be obtained in regard to their protective value."—Again, they state: "Owing to the nature of corrosion it is probably true that no perfectly reliable acceleration test for corrosion resistance can be devised. Corrosion is the natural process of rust formation, that is to say, in very slightly acid media, is a question of comparatively slow growth under special conditions, and any effort to hasten the action changes all the conditions of equilibrium, producing an entirely different order of phenomena."

The opinion that the physical state of the paint after it is manufactured is a more vital factor than the composition of the paint and the importance of exposure tests to demonstrate paint value, is also emphasized by J. C. Smith in his paper to the International Association for Testing Materials at Copenhagen in 1909 as follows: "Although opinions vary as to what are theoretically the best pigments, or more correctly, combination of pigments, for the manufacture of protective coatings, the general consensus of technical opinion seems gradually to be that with certain more or less obvious reservations, the composition of the paint is less important than its physical state and that one pigment or blend of pigments is more efficient than another as the basis for a protective paint mainly according to the degree in which it tends to produce certain definite physical and mechanical effects in the ultimate protective film. The problem that remains is the selection of that blend of pigments, suspended in a suitably adjusted vehicle (the paint as a whole possessing the necessary physical properties) which will under known conditions as to exposure and climatic conditions, yield a satisfactory protective film. Only exposure tests can solve this problem."

Not Sufficient Consideration of Conservation

In the past, more steel structures have been superseded because they were inadequate to meet modern development and not because the lasting quality of the structure had become impaired. The feeling among engineers in consequence has been that paint materials and the subject of protection were minor considerations and therefore there has been no economic demand for improved application or shop practice.

Because of the demand for steel construction, engineers generally have devoted their attention to developments in design and the subject of conservation or maintenance of the structure has been allocated as of secondary consideration. This is demonstrated by the fact that many engineers ignore the effect of variations in qualities of materials built into an exposed structure and by the fact that most of the tests on corrosion have seldom been completed or followed up.

Some engineers are now taking a more active interest in corrosion because of the present demand for conservation. The cost of steel construction and the realization that these are handicapped under present practice by heavy maintenance charges, which if capitalized, would necessitate a very large investment to provide interest to meet them, are apparently responsible for an economic demand to reduce maintenance costs.

Efficient protection of iron and steel structures by paint can be obtained only when the true causes of corrosion are appreciated and effective means taken both in the design and maintenance of a structure to combat these causes. At the present time no absolutely indestructible or permanent protection is known, but by the use of properly selected paints in conjunction with efficient design and application, maintenance work may be reduced to a minimum much below the present average and the structure maintained without appreciable deterioration.

The Cause of Deterioration

The deterioration of steel structures is caused by electro-chemical action between the steel and the surrounding elements or, what is often overlooked, by similar action between various members or portions of a structure. A brief explanation of such electro-chemical action in its relation to steel might be worded as follows:—

All ferrous metals when placed in water or in an atmosphere which acts as an electrolyte, or in such conditions of exposure that a film of moisture may condense on them, tend to dissolve. This tendency is governed by impurities, unequal stresses and unhomogeneous nature of the metal in each case, and by the impurities in the liquid or gaseous film. Certain points in the metal, which have varying tendencies to go into solution, form electrodes of opposite nature, and corrosion takes place in proportion to the potential difference between these points, governed by the value of the electrolyte connecting them. The more concentrated the hydrogen ions in the electrolyte (for instance where acids are present) the higher will be its electric conductivity, and the more rapid, consequently, the corrosion of the positive electrode.

It is evident therefore, that in a fabricated structure this action between points applied not only to each surface in detail but to the whole structure where the sections and members may be of varying composition or subject to initial stresses.

Owing to the process of manufacture by heat, steel plates and shapes are always coated with scale which is the black magnetic oxide of iron. This, though it has at first a metallic blue sheen, is not part of the metal, and as it is electro-negative to the steel or iron, it forms a surface which actively promotes corrosion from the moment it is exposed unprotected to the atmosphere. This corrosion is hastened in proportion to the amount of moisture in the air and any acid present.

The mill scale as it corrodes changes into a hydrated red oxide of iron holding 24 per cent of hydroscopic moisture which is never dried out under atmospheric heat conditions, but acts as an accelerator of further corrosion. As this change takes place the scale increases to more than double its bulk, gradually loosens and flakes off.

The Effect of Paint

Paint applied on top of corroded scale, even though the oil appears to penetrate the scale, will only retard corrosive action but will not neutralize the electro-negative polarity or bond the scale to the underlying metal.

The oil cannot displace the moisture already present in the scale; therefore the paint merely acts as a covering under which active corrosion proceeds. The gradual increasing bulk of the scale under this action stresses the paint film as it is lifted from the metal, while the iron oxide formed has a tendency, where oil or varnish vehicles are used, to make the paint film brittle, with the result that holes and cracks develop in the film through which moisture penetrates under the paint and corrosion is further promoted. Blue mill scale adheres so firmly to the metal that it can only be removed by means of the sandblast or the pickling process. It is also practically impossible to wholly remove partly corroded scale by wire brushes, scrapers or hammers, so that under the best practice for protection this also should be removed by sandblast or pickling process. So long as any mill scale remains on the steel surface, one has a potential corrosive agent under the paint which will become active the moment contact can be established through an electrolyte with the metal.

An effort along the lines of improvement is illustrated by the fact that the largest steel fabricating shop in this country has recently installed a pickling plant and is prepared, if customers are willing to pay the cost, to treat steel in this way and in consequence remove the mill scale before the first coat of paint is applied.

It is evident from the explanation of corrosion that the function of paint is to act as a lasting insulator between the electrodes of varying solution tension or electric potential value and prevent contact between these and the electrolyte.

What Paint Should Accomplish

The problem in practice is not only to obtain this quality, but to combine in the film the following necessary features the lack of which, would result in expensive maintenance:

1. The film must be suited to the exposure to which the structure is subjected in order that moisture or gas acting as an electrolyte may not penetrate the paint and overcome the insulation.

2. The paint must adhere so closely to the surface that in the event of any local damage to the film no source will be established from which corrosion can creep under the paint and in time remove the whole in flakes or sheets.

3. The film must be tough and elastic in order that it may withstand abrasion and in the event of

any mill scale under it, resist for the longest period without fracture.

4. It must be of such a nature that as it loses its value, due to exposure, and recoating becomes necessary, a suitable surface is left on which to apply maintenance paint so that minimum expense may be involved.

Protection by a single application heavy film paint has been sometimes advocated, but in the first place it is almost impossible to obtain such a paint with toughness and penetrating the film as required, combined with adhesive and waterproofing qualities, etc. In the second place, such a film would require to be applied before the steel was fabricated in the structural shops in order to protect the steel before the blue scale becomes corroded and scaling started; in which case it would probably become damaged during transition through the shops, transportation to the site or during erection of the structure. To arrange for it to be applied in the field after erection of the structure would entail expensive cleaning of the steel under difficult inspection conditions and trouble would certainly arise in the treatment of many inaccessible or intricate built-up sections.

No Single Coat Paint is Satisfactory

Paint makers are constantly experimenting under working conditions at their plants to develop improvements on the protection of steel, but so far no single coat paint has been developed that has given satisfactory results combined with practical efficiency.

The practice which has produced most satisfactory results has been when a combined film is built up of two or three units, each one adapted to the specific purpose required of it.

The combined film must have integral freedom from impurities such that it will not permit outside elements, or ingredients in its composition in conjunction with outside elements, to form electro-chemical combinations and promote corrosion. This film must have sufficient thickness to ensure efficient life as the action of the elements causes gradual oxidation and disintegration.

The first unit of a combined film is the shop coat, the function of which is to prevent the start of electro-chemical action on the surface while the steel is easily accessible and so form a base on which exposure or field coats are placed. As it is the base of all protection, it should receive the most careful consideration. It must dry hard with strong adhesive and anti-corrosive qualities and yet be sufficiently elastic and waterproof to resist damage in the handling of the structure during its transition through the fabrication shops and for a period long enough until the steel is erected, otherwise corrosion of the surfacts is started before the exposure or field-coats are applied. It must be a light coat, otherwise when used as an assembly paint between surfaces in contact through which hot rivets are driven it is liable to burn out forming gas pockets and be the cause of loose rivets. It should be easily spread in order that it may be worked into all portions of a built-up section without difficulty by the shop labor.

The second unit in the combined film should be applied on top of the construction or shop coat of paint, after the structure is erected and any abraised portions have been spotted with the shop coat. This paint is required to build up the paint film and form a reservoir life for the exposure paint, also to ensure that the shop paint which has weathered during erection of the structure is reinforced and free from any minute checking, especially if the structure is large and has taken some time to assemble, or where it is composed of light sections the edges of which are difficult to cover with one coat of paint. This paint should be a steel-surface anti-corrosive paint but slightly more elastic than the regular shop paint.

The third unit in the combined film is the one subjected to the exposure and just as the shop coat is the base on which the paint film is built up and on which depends the success of protection against electro-chemical action on the surface of the steel, so the function of the exposure coat is to protect the shop coat against the various conditions to which the surface is subjected during its exposure.

It is evident that the conditions which govern steel buried in the ground where the paint film is subjected to fairly uniform temperatures without sudden change but constantly to the action of moisture impregnated with mineral salts, etc., are entirely different to the conditions governing exterior atmospheric exposure where the action of the sun and frost with temperature variations of over 120 degrees Fahrenheit call for altogether different qualities in the exposure paint film.

One of the causes of high maintenance costs in steel structures is the neglect to apply paint on an exposed surface until not only the field coat of paint has lost its vitality, but corrosion has so far attacked the undercoating that bare portions of the steel are exposed and thereafter applying only one coat of field paint, It should be remembered that in many cases the most effective field coat is not a proper shop or steel-surface paint and that it may not stop corrosion spreading under the surface if it is not applied on top of an anti-corrosive paint. If corrosion is far advanced on a structure, at least two coats of paint should be applied after the surfaces have been thoroughly cleaned, and the first of these should be a real anti-corrisive steel-surface paint fulfilling all the requirements of a shop or construction paint.

What to Look For in Paints

There are one or two essential points in the use of steel paints, however, that should be carefully considered by purchasers when in the market for paint:

1. The manufacturer should always be advised of the exposure to which the paint will be subjected and if possible the nature of the paint already on the surface.

2. Paints containing linseed oil should not be applied on top of asphaltic paint as action will set up between the paint films and the protective value of both coats will be destroyed.

3. Paints containing linseed oil should not be applied over or under tar paints, as similar action will occur and active corrosion may be immediately promoted.

4. Paints should never be purchased on the basis of price per gallon as this does not give any comparison of either cost of work or service done. Comparative costs should be based wholly on service records of paint and cost of application per unit of tonnage or area.

It may be of use to have the approximate tonnage of various structures which may be covered by one gallon of good paint (one coat) based on the thickness of sections:

Sections 3/16 to 1/4 in. thick—transmission towers,— 1 1/2 to 2 tons per imperial gallon.

Sections 3/8 to 1/2 in. thick—light mill buildings, highway truss spans,—2 1/2 to 3 tons per imperial gallon.

Sections 1/2 to 3/4 in. thick—medium building construction and light railway truss spans,—3 to 3-1/2 tons per imperial gallon.

Sections 3/4 to 1 in. thick—heavy building and railway girder spans,—4 to 5 tons per imperial gallon.

My thought in presenting this paper on "Paint as a Protection for Steel Structures" is that it may awaken interest in this important subject and that an effort may be made to improve the general practice of protection.

The results of service records are the base of all future economy and reliable records can be obtained only when an effort is made by everybody interested to co-operate in the selection and use of good paints and their proper application.

Victory Bonds for Guarantees

It is No Concession to Accept These in Place of Cash as They are Merely Equivalent to Accepted Cheques

There appeared in the columns of the "Montreal Daily Star" on or about the 15th of September, an article under the caption as above, in which it was said, in effect, that the city of Montreal has declined to adopt the acceptance of guarantee bonds, as suggested by the Builders Exchange, in lieu of accepted cheques, but have conceded the option to the contractor of depositing Victory Bonds.

The circumstances of the concession made as to filing Victory Bonds in place of accepted cheques, makes it obvious that the city authorities do not understand the object of the suggestion of the Builders Exchange.

Certainly there can be no advantage to the contractor to deposit Victory Bonds which represent so much cash, instead of an accepted cheque, which represents so much cosh.

If the city, in place of taking an accepted cheque, would take the surety bond of an accepted guarantee company, it would have the effect of guaranteeing to the city the performance of the contract in accordance with its specifications, and make avaliable to the contractor resources for the completion of such contract, which otherwise are curtailed by reason of the accommodation incidental to the accepted cheque accorded him by his bank.

The adoption of guarantee or surety bonds issued by accepted companies in lieu of accepted cheques or other security has been more or less universal throughout the United States, including the Treasury Department of the United States, as also have they been adopted and are in general use in Toronto and Winnipeg and various of the municipalities and governments of the Western provinces, and to some extent the Maritime Provinces.

With the exception of the surety bond given by an American company for the completion of the first Quebec bridge and the various bonds given to the Department of Marine and Fisheries in connection with guaranteeing the completion of various ships that were built for the Canadian Government Merchant Marine, and the bonds to the Inland Revenue Department, the Dominion Government, province of Quebec or the city of Montreal have not adopted the acceptance of surety bonds of accepted guarantee companies in lieu of accepted cheques or other security.

That the bond on the collapsed Quebec Bridge or those issued on behalf of the defunct Prince Rupert Drydock and Engineering Company and Dominion Shipbuilding Company were not collected, should not prejudice the general premises.

Besides the convenience to the Dominion Government, the province of Quebec and the city of Montreal, and the advantage to the contractor, by the acceptance of surety bonds in lieu of accepted cheques or Victory Bonds, there are other features pertinent for consideration.

The Dominion Government, province of Quebec and city of Montreal are receiving, in one way or another, taxes from the several companies transacting business of "guarantee insurance;" and yet they refuse to accept the "guarantees" for which those companies are licensed to undertake and taxed.

"Guaranteeing insurance" as interpreted under the Dominion of Canada Insurance Act of 1917, means "the guaranteeing of the fidelity of persons in positions of trust, public or private; guaranteeing and becoming security for the due performance of any contract."

An accepted cheque on a chartered bank, as when required, is deposited for the purpose of guaranteeing the due performance of the contract at between the contractor and the City, or in other words, it becomes an instrument of guarantee insurance.

Presumably when a chartered bank accommodates a contractor with an accepted cheque, either on deposit of collateral or his promissory note, the contractor's account is charged with the amount of the accepted cheque, as also with the current rate of interest thereon.

On the basis of the contractor being required to give security for say, 20 per cent of a contract of $100,000, the interest payable for the accommodation of the accepted cheque for $20,000 would be not less than $1,200 per year, as against a premium, (if tariff is adhered to, which it is not always) of $1,000 covering a period up to two years.

Unless these accepted cheques are cashed by the Dominion Government, Province of Quebec or City of Montreal, and circulated in disbursement of the respective governments' obligations, the object of insisting upon them, without other alternative than deposit of Victory Bonds, to the inconvenience of their handling by the respective governments and without advantage, but, in many cases, to the disadvantage of the contractor, is not apparent.

Pittsburgh Water Heater Co., Establishes Toronto Office

We are informed that the Pittsburgh Water Heater Company of Pittsburgh, Pa., have established a Branch Agency in Toronto to take care of their Ontario business. Mr. E. M. Paterson will represent the Company and manage the local branch. Display rooms and offices are being fitted up at 504 Spadina Ave., Toronto, and all architects, builders and contractors are invited to visit these premises and judge for themselves of the merits of the Pittsburgh line. The Pittsburgh line includes water heaters suitable for every purpose and of sufficient capacity to meet every requirement. There are 18 sizes, with capacities ranging from 2 gallons a minute to 5,000 gallons an hour.

Can Contractors Obtain Better Equipment?

Is Standardization Possible?

Four Viewpoints as Expressed at a Joint Conference of Equipment Manufacturers and General Contractors

1. Standardization is Desirable and Practicable

By Leonard C. Wason, President, Aberthaw Construction Co., Boston

I would sum up my subject—Standardization of Equipment—thus. Is it practicable? Yes. Is it advisable? Yes. To what extent? Everything.

We need equipment men to help us, because we are really manufacturers in the sense that we assemble crude materials into a finished product. Especially is this true of concrete. We manufacture it into its final assembly. You simply furnish us the tools with which to do this to some extent. In Asia, where labor is worth only a few cents an hour, one cannot afford to use a plant. On this continent where the other extreme is to be found, the highest paid labor in the world, plant is most desirable and most necessary. In industrial building construction, the mechanical plant runs about 5 per cent of the contract, while the labor of the general contractor is 35 per cent. If we could add 5 per cent to our plant and deduct 5 per cent or more of our labor, we would be delighted to do it. You can help us do this.

Success Through Transportation

If you will analyze the plant that is used in transportation—I use that term in the broadest sense of moving materials from one place to another, and in this sense a shovel is an item of transportation, of course,—the greater part of our plant is used in transporting material.

Years ago, when I read the history of the Standard Oil Company, I was very much impressed by the fact that their gain in wealth and power came through their mastery of transportation; to be sure, they did it in rather underhanded ways and secret rebates, but they mastered transportation. Assuming that on the manufacturing end others could produce as cheaply as they and buy raw material as cheaply as they, yet the Standard Oil Company could move its product from one place to another more cheaply and there lay the secret of its success and power.

In construction work, in building, especially there is more hand labor used than in any other form of manufacture that I can think of, and particularly is this true of the final assembly. I have never been able to think of a tool which could possibly lay bricks, or assemble lumber in a house. But if you gentlemen, devoting your attention to equipment, can concentrate your thought on the final assembly of building material and master those two problems alone, you will be a great blessing to yourselves in the way of selling equipment and a great help to the industry and the individual contractor.

Advantages of Standardization

Now, what of standardization? What are the advantages to the contractor of standardizing?

Very briefly, he saves in the number of sizes of the machines which he has to carry. If he has from 12 to 20 concrete mixers, he saves in that he has to carry only one manufacturer's machine in the two sizes. When the machine is practically worn out, it is possible to take the repair parts off an old machine and put onto a new machine; and, if those parts happen to be good, he will have a new machine where before he had a collecion of old ones.

Another saving is that in the ordering or carrying of repair parts, he has to stock only one kind. The master mechanics on the job understand that machine and can repair it, and can do it much easier and cheaply than they could if they had several different machines. Then the question of operation enters in and, if there are only two machines, the operators know how to operate both of these machines.

Another reason for standardization is the matter of service. If there is located in our territory a certain manufacturer of equipment, while other manufacturers may produce just as good, since he is right there to attend to service at a moment's notice, if we specialize in his equipment, he is going to be able to give us service cheaper and better when standardization is in effect. Of course, not all manufacturers can maintain depots in every large distributing centre, but on certain lines it seems to me perfectly possible. Different manufacturers might make tools so that they are interchangeable. Boilers have long since been standardized as to capacity, hoisting engines likewise, and one could pretty nearly buy a boiler or a hoisting engine from several manufacturers where the parts would be interchangeable. If that were done, the contractors would have the advantage of competition, which would be like the different branches of one big organization competing with one another to get the best results possible. If I were doing business in a locality very distant from our base, I could buy the equipment of some manufacturer at that point to fit the equipment that we had already on the ground, and it would be a benefit and a great saving to me.

How is Equipment Selected?

How do we make selection? Sometimes it is possible by a study of catalogues, or by examination of machines in operation. If they have been sufficiently perfected, so that we can try out several, from that experience with several we can determine which is the best one to use.

To what extent shall we standardize? Some articles I would not recommend that the contractor carry in stock; a derrick is one. Years ago we had to use a derrick between two buildings where it was necessary to reach the entire space between two walls with a certain length of boom. We went to a dealer who rented them and who had 38 different derricks in stock, and not one fitted; he had to make a boom to fit. If that usually happens, there is no sense in a contractor carrying equipment of that type. But he certainly should carry equipment of the type that he uses constantly and which is not changed.

That brings up the thought that, if it is not to be used constantly, there might be a standard design which can be rented if it is desirable to do so. Unless one keeps a piece of equipment busy on one's own work, or that of others, it is not profitable to own it.

It is also desirable from the contractor's viewpoint to deal with a manufacturer who changes his standards slowly, so that a contractor does not have to be changing repair parts to be inconvenienced by having machines of two different styles, the old and the new. That is almost as bad as two different manufacturers. Certainly, if a manufacturer does make changes, he wants to prove himself successful. If they are not desirable and economical from the contractor's point of view, he should adopt the attitude of letting well enough alone and waiting until he is absolutely sure before he makes the change.

Job Instruction for Equipment

I think it is perfectly possible for the manufacturer to write out job instructions for all our equipment. My firm has printed job notes, standardized for its job superintendents, and they write out special ones for the particular jobs which have peculiar points. Therefore, I think it is just as feasible for a manufacturer to have standard instructions or job notes to send out to contractors. We have shown that they can be sent out with good results to job superintendents. I know that, when I have bought new machines and have gotten job instructions with them, I find it mighty difficult to get a duplicate. It occurs to me that, if duplicates were made, if the manufacturer could not afford to give them away, a small charge could be made to cover the cost of printing.

I would like to emphasize in closing the suggestion made by various others, that we form a conference committee between the general contractors and the manufacturers of equipment so that, by getting around the table, we can work out our problem together and solve the difficulty; when we meet face to face and learn that the other fellow is a real fellow, when we see his problem, we are more sympathetic and considerate, and we reach the conclusion that it is to our mutual advantage to work out these problems together rather than trying to work them out alone.

2. *How Can Contractors and Manufacturers Work Together?*

By W. A. Rogers, President, Bates & Rogers Construction Co., Chicago

We contractors cannot do our work unless we have proper machinery, well operated. The day of hand labor is pretty nearly past. We are dependent to an increasing degree on satisfactory machinery. Our company has always tried to work out a very close relationship with the people who furnish equipment. I feel that they are among our best assets. Some of the best friends I have had in my construction experience have been some of the old-time equipment people, with whom we have had pleasant relations trying to work out a satisfactory machine to do our work.

I remember very well one or two men who are now dead, who were in the equipment business when I was more actively on the work, who used to come to me and go out on the job and look over the machine and talk over the weak points and discuss where the machine could be improved, and then those old fellows would go back to their shops and send out an improvement for us to try out. We would try it out, and nine times out of ten it worked fine. I think this is the ideal relationship between the equipment man and the contractor. I think that such means will go a long ways toward developing a feeling of partnership.

If we go back into the past history of most of the machines we use in our business, we will find that the idea was conceived in the mind of some contractor who was trying to improve on his methods; then the mechanic, who developed into the manufacturer, took up that idea and worked it into concrete shape. Unfortunately, the tendency, as the contractor company gets larger, and the equipment company gets larger, is to draw apart. You, who were in close touch with the operation of equipment a few years ago, get so that you do not have that close touch; you who manufacture machines sit in your office and have a high-paid chief engineer who designs something that the contractor ought to like, or that ought to be satisfactory to the contractor. The contractor cusses the fellow because he does not know his business. We do not get together as we used to, and as we ought to do if we are to be successful. I think that is something we ought to mutually overcome. When a machine is not doing the business on the job that it should do, we are losing money, we are not doing the work we ought to and we are not doing it efficiently. So, when I talk to manufacturers of equipment, I like to speak for a closer co-operation between the equipment people and our organization and our members; and I think this meeting is a step in the right direction.

Send Experts to Sell Machines

When sending a man to sell a machine, send a man who knows the machine and not a fellow who has learned to speak his piece and that is all. Send us an expert who knows how it ought to work on the job. Send an expert out on the job to break in a machine, or to help us if it is broken down; send somebody who knows more about it than we do. I venture to say that, if you have talked to many of the contractors, you have found a lot of fellows who have a feeling of contempt—at least—for the so-called "expert" that is sent out on the job today to show us what is wrong with the machine, or how to fix it.

Another way in which I feel we can help the equipment man is, by advising him to be very slow about giving out so-called "costs of work." There is a lot of data regarding costs of work disseminated that is criminal, to say nothing of unfortunate. There are a lot of young fellows going into the contracting business to furnish bids based on costs furnished by equipment people, and the costs are all wrong. I would like to impress it on you equipment men, that you should be very chary about going around talking about costs or in sending them out. Costs must be interpreted in connection with the local condition and everything that goes with it.

We contractors have a very vital interest in quick deliveries of repair parts. Ninety-nine times out of a hundred, when a repair part is ordered, it is ordered because the machine is broken down. Of course, we should anticipate that and have the repair part before it does actually break down, but we haven't reached that stage of perfection yet. If you can strain a point to get that repair part to us, you will make a friend for life. If you delay getting the repair part to us, perhaps we won't buy from you again.

3. How Dealers Can Give Better Service

By H. B. Bushnell, Western Wheeled Scraper Co., Aurora, Ill.

I am sure that the manufacturers of equipment that is used in construction work are, as a whole, more than willing to co-operate with the contractors in the matter of service.

As we look at it, a sale is not a good sale unless it results in a satisfied customer; and my experience has been that you cannot keep a satisfied customer unless you give him service. Merchandisers have come to realize more than ever that service is an integral part of sales.

For our part, we aim to anticipate the actual construction of highway programs by the establishment of either a direct office of our own in the form of a salaried employee, or, if that is not advisable, through some equipment dealer.

Our company is not able to have its own direct sales organization and warehouses everywhere, but strung out over in what appear to be good locations, we have our own warehouses from which we aim to serve equipment dealers or jobbers.

Where distribution and service is accomplished through the dealer, there is one drawback—one does not have absolute control over his business policies.

Dealers Sometimes Fail to Give Service

Complaints occasionally arise, we find, from contractors who go to our dealers and ask for service. Unfortunately for us, and for the contractor, our dealers do not always give the service that we would like to see them give. Another objection is, neither do they extend credit that we in the home office would extend. In the matter of repair parts, I would like to offer the suggestion that, when a contractor moves into a new territory where he is going to deal with a jobber or a dealer rather than direct with the home office, if he notifies the home office that he is starting a job in that particular locality, it will be to our mutual advantage. If he does not already know who is the dealer, he should find out and ask that any orders placed with that dealer be honored. Those dealers may not know Jim Smith from Baltimore; we may know him in our home office; but if they don't know Smith, naturally he does not get the credit or the service he would get if the dealers knew the contractor's rating.

Another source of complaint arises from the fact that a contractor will start a branch office—say, in Podunk, Kentucky. He wires in for a repair part, signing his name, "Brown Bros., Podunk, Kentucky." We have no record in our books of having done business with that man, and no credit rating for him. I think the average manufacturer tries to assume the burden of the man's credit. I know that that is the case with our company; and if by any way possible we can convince ourselves that he is entitled to it, he gets it. But to refer back, we cannot find any clue to Brown Bros. at Podunk, Kentucky. If the wire were to specify "Brown Bros., of Baltimore, Maryland, field office at Podunk, Kentucky," the whole matter would be simplified and very easy to handle.

Demand Governs Repair Parts Stock

In the matter of carrying repair parts (which means service to the contractor), practically all manufacturers are governed by the demand. Where one has his own branch that demand can be anticipated; where relations are conducted on a consignment of stock basis, the situation can be controlled. But the demand may not be great enough to warrant the expense of a branch office under direct control; at the same time, a certain service is due to the contractor. The best way that we have found, and the only way we could solve it economically, was through dealers who handle several lines of equipment, thereby reducing their overhead expense. We have no control over that class of dealers as to what repairs will go into their territory, that dealer buys and sell parts. If the contractor who is doing business in that territory will confer with our home office, saying: "I am held up for repairs for this or that machine," we can immediately get in touch with those dealers and anticipate the contractor's demand.

A contractor going into a new territory should make a practice of advising the manufacturers of all the equipment that he is going to use on that job. He might say: "I am going to do a job in Iowa; I have some of your machinery, and in all probability I will need repairs. Where can I get the quickest service?" Then the home office advise him as to the location of the nearest service station.

Order May be Lacking in Information

To go farther than that, they should supply him with a repair parts catalog. It is surprising, the lack of information that may come in with the repair part order. A man may order a repair part for a Wheeler; he doesn't know what size it is, and neither do we; he may order a repair part for a grader or a steam shovel, or any number of different articles of machinery, and it takes a lot of good guessing to come anywhere near filling an order on the information, especially that information which comes in by telegraph. If the guess is wrong, the manufacturer is out the transportation charges, which is a part of the ultimate cost. The contractor gets the wrong repair part, resulting in a delay and lack of service. We attribute a large part of that, not to the contractor himself, but to the foremen and superintendents on the job. A great deal of annoyance and expense could be saved to the contractor if, when starting a job, he would instruct his superintendents to write to the different manufacturers and get repair parts catalogs for all the machinery used on the particular job.

The progress of the general contractor is usually dependent in a measure on the progress of his sub-contractor. Some of these sub-contractors are unknown to the manufacturer. Suppose that the manufacturer gets a letter or a wire asking for repair parts. He knows nothing about that sub-contractor. The result is, many manufacturers send the repair part C. O. D., which may be embarrassing.

Back "Jim Jones"

If the general contractor would write to the manufacturer and say: "Jim Jones is subbing for me; I will guarantee his account," or, in case he does not want to assume that responsibility, if he would give his own judgment of the man, the manufacturer would have some idea of whether the sub-contractor is a deadbeat or a responsible individual. In the big majority of cases, the manufacturer would be willing to go half way on any deal of that kind.

We can appreciate that the contractor's field office is quite often not in position to take up a big C. O. D. bill. They will have money to meet the payrolls, but not much cash balance besides. That trouble and annoyance can be saved if the general contractor will tell the manufacturer in advance to honor orders from the superintendents.

4. The Effect of Standardization of Wheelbarrows

By H. H. Baker, Sterling Wheelbarrow Co., Milwaukee, Wis.

When we started in busines, it was in an industry that is about as old as the hills and it was a tough game. Twenty-three years in the business has convinced me that there never was such a demand for wheelbarrows as there is today, despite the fact that advertisements tell contractors to put in a loader and do away with wheelbarrows. The wheelbarrow is here to stay.

I have referred to the game as being a tough one. The main point was how cheap and how poorly to make a wheelbarrow, and yet the merchandizing was all done through jobbers. First, the jobber, then the retailer, and then, eventually, the ultimate consumer.

Jobbers would order on contract, possibly, 1,000 dozen or 1,500 dozen wheelbarrows. They would tell the manufacturers how to make them; how thick or how thin they wanted the frames or wheels, and what color to paint them. We tried to buck the game; and after six years we found that we had a lot of antiquated machinery, any number of different models, we weren't getting anywhere, and we hadn't made a dime in seven years.

Competition Caused Style Multiplication

It was the same old fight, namely, price. The question in our minds was whether we would revolutionize the wheelbarrow industry, launch out on our own hook and turn out a standardized product, or quit. At that time we had 165 different types of wheelbarrows. That situation was not brought about by the consumer's demands except in a very few instances, but in general it was caused by competition. One manufacturer would make a barrow three feet long; some other fellow would cut off half an inch on the tray in order to make it cheaper, and he had a new wheelbarrow and gave it a new number, just simply for the price, and price alone. So, when we started to standardize, we started with 30 styles and threw out the balance of the 165. We are still making 30, but we feel there are 20 too many now.

Standardization was the main theme; when it came to throwing out such and such a type of style, the objection was: "We cannot throw out this wheelbarrow because so and so makes it." We declared a strike. Others then brought their styles of barrows down and reduced the number every month. Over a period of years we found that there were some styles of which the whole 24 manufacturers had made in all only six. It had been assumed there was a market for them, but there was not. We made at one time over 24 different frames, some hardwood, some steel, some all wood, and the holes were not all bored the same.

Standardizing

Now, we have only one kind of lumber and one kind of frame, and all the holes are punched the same. If the consumer wants a particular kind of handle, he orders that handle and it is cut to fit. We redesigned all of our trays, and, instead of having 26 different styles, we have now six, and all the holes are punched exactly the same. The result is that any tray, regardless of capacity, will fit the same frame.

We had 13 wheels, strange as it may seem, and now we are getting by very nicely with one wheel, and we have no demand except for that one wheel.

The result in our company has been astounding. Today we are turning out in the woodworking department with 12 men 600 pairs of wood handles a day. We used to employ 15 men to turn out less than 300 pairs.

Standardization is our strong forte. It has helped us wonderfully, in that we can get along with half the force and turn out twice as many wheelbarrows. I should think that the contractors and the manufacturers could adopt that plan. Standardization of equipment saves time all around; it saves time in ordering repair parts; it saves the time of the repair man or mechanic. It seems to me that the contractor could well afford to standardize his equipment—it would be economy for him in maintenance.

We had an experience in our export department with a certain company in New York, which started out to get the contracting business on a big scale, with about 20 branch offices in different parts of Europe, and put in a stock of machinery. In about six months they ran up against a snag caused by two things; too many different types of gears and too many different types of chains. Those were the two major defects. They had to carry an enormous stock on hand—I think they had 26 different kinds of chains. Sometimes a man waited six months to get a piece of chain from the United States. They employed a man to standardize their chain gears on mixers and heavy equipment and bring them down more toward a standard. It was almost impossible to carry chains and repair parts. They cut down to six or eight chains, which will all serve the same purpose.

Stardardization will save time and expense.

Power Plant for Hanna, Alta.

J. E. McFarlen, of Hanna, Alta., contractor, has been awarded the contract for building a power plant for the town of Hanna, Alta., at an estimated cost of $5,300; and E. Kelly, electrical contractor, of Stettler, Alta., has been awarded the contract for remodelling the transmission lines at an estimated cost of $1,200; also wiring of power house, contract price $300. It is expected the plant will be in operation by the 15th December of this year.

Annual Convention A.C.B.C.I. Feb. 6-9,
Chateau Frontenac, Quebec City

How to Use Portland Cement Stucco

What It Is and Directions for Making and Using It—Methods of Finishing and Coloring—Details of Construction when Stucco is to be Used

By the Portland Cement Association

Portland cement stucco is a material on which architects and homebuilders easily agree. Its attractive appearance, durability and its adaptability to individual treatment, make it the preferred material for the expression and preservation of the builder's architectural ideals. Portland cement stucco is reasonable in cost, and renders splendid protection against fire and weather.

Evidence of the preference accorded stucco by builders in all ages, has come to us from the historic past. The Greeks, Romans and Egyptians used stucco in a number of famous buildings which have been universally recognized as architectural masterpieces. Today, stucco made of the modern portland cement is stronger and more durable, and when built in accordance with the recommendations contained in this article, will give pleasing and satisfactory results.

Excellent examples of the use of portland cement stucco abound in both the extreme cold and warm climates. The same is true in the extremes of moist and dry atmospheric conditions. The recognition accorded portland cement stucco by the architectural and engineering professions commends it to the builder as a safe and satisfactory material for general use.

In addition to the purely structural and practical adaptation of portland cement stucco, it affords the architect an unlimited opportunity to carry out color composition. Colors of any desired tint or shade may be obtained by the use of mineral coloring pigments, and by the use of special, colored aggregate a great variety of color and shadow effects may be had.

Portland cement stucco is easily cleaned or freshened and requires no painting, thus reducing maintenance and preserving the original appearance of the building.

What Stucco Is

Portland cement stucco consists of a mixture of portland cement, sand, hydrated lime and a sufficient amount of water to produce a workable mix, applied to a suitable surface and permitted to harden. Successful use of stucco depends in a large measure upon the structure to which it is applied. The surface to be stuccoed should be free from loose parts and be rigidly and firmly supported. Drawings in this article show typical details of standard stucco construction.

Recommendations for Making and Using Stucco

Cement—Cement for stucco should meet the requirements of the Standard Specifications for Portland Cement of the American Society for Testing Materials.

Fine Aggregate—Fine aggregate should consist of sand or pebbles, free from dust, loam, vegetable and other foreign matter. It should be graded from fine to coarse and its largest particles should pass a No. 8 screen.

Water—Water should be clean, free fram acid, oil, alkali and vegetable matter.

Hydrated Lime—Hydrated lime should meet the requirements of the Standard Specifications for Hydrated Lime of the American Society for Testing Materials. When used it should be carefully measured and added to the sand and cement dry. The amount of hydrated lime in no case should be more than one-fifth the volume of portland cement.

Color—Permanent mineral colors only should be used in stucco work. These colors should be fully guaranteed by their manufacturer to be unaffected by lime, cement, or weather. The amount of coloring used should not be more than 10 per cent of the weight of the portland cement. The coloring matter and fine aggregate should be mixed together first and then the cement added. The whole should then be mixed dry by shoveling from one pile to another through a one-quarter inch wire screen until the entire pile is uniform in color. Water should then be added to bring the mortar to a proper plastering consistency.

Hair or Fibre—Hair or fibre should be used in the scratch coat only when stucco is applied over wire lath that is to be back plastered or on metal or wire lath applied over sheathing and is separated therefrom by furring deeper than 3/8 inch.

Proportions—The mortar for all coats should be mixed in the proportion of one part by volume of portland cement, to three parts of fine aggregate. A sack of portland cement is considered as one cubic foot. The exact proportions of materials for the mortar including water, must be uniformly maintained throughout the entire job.

Mixing—Mortar can be mixed best in a mortar mixing machine. The period of machine mixing should not be less than five minutes after all materials, including water, are in the mixer. When hand mixing is necessary it should be done in a watertight mortar box and the materials mixed dry until the entire mass is uniform in color. Water is then added and the mixing continued until the consistency is uniform throughout. Use only enough water to produce a workable mix. The less water used within working limits, the better the quality of the mortar. Mortar which has begun to stiffen or take on initial set should not be used. Mix only the amount of mortar that would be used within thirty minutes.

Procedure—The plastering operation is to be carried on in one general direction without permitting the mortar to dry at the edges. If impossible to finish a full wall at one time, the joints should be made at the same natural division of the surface, such as a pilaster, door or window.

First Coat—The first, or "scratch," coat should have an average thickness of 1/4 inch over the lath, or base. It should be well trowelled into the lath, or base, to obtain a thorough bond, or key. This coat should then be heavily cross-hatched to provide a strong mechanical key for the next coat.

Second Coat—The second, or "brown," coat should be applied the day following the placing of the first. The first coat should be dampened, but not saturated, before the application of the second coat. The second coat should be from 3/8 to 1/2 inch thick, and should be brought to a true, even surface by frequent testing with a straight edge. When stiff enough, it should be floated with a wooden float and lightly and evenly cross-hatched to secure a good mechanical bond for the finish coat. The surface should then be sprayed and wetted and kept from drying out for at least three days.

Two-Coat Work—whenever two-coat work is required, the first coat should preferably be "doubled" —that is, as soon as the first coat is stiff enough, it should be followed by a second application of mortar, and this should then be treated as described under "Second Coat."

Back-Plastered Work—In back-plastered work, the backing coat is preferably applied directly following the completion of the brown or second coat. The keys of the scratch coat should be thoroughly wetted and the backing coat immediately applied to a thickness of 5/8 to 3/4 inch and should be finished 1/4 inch back of face of studs.

Finish Coat—The finish coat should not be applied until at least one week after the application of the second coat. All finishes described later require that the finish coat should be brought to a smooth, even surface with as little rubbing as possible before the addition of materials for finish surface. The sand for the finish surface should be well graded from fine to coarse.

Curing—The curing of all under-coats by sprinkling and the protection of the finish coat against sun, wind, rain or frost by the use of tarpolins is always to be recommended. All coats should be permitted to dry out very slowly, retaining their original water content as long as possible.

Freezing—Stucco should not be applied when the atmospheric temperature is below 32 degrees F. If necessary to complete a small portion of the job in cold weather, canvass should be used to protect the newly placed stucco from freezing.

Finish

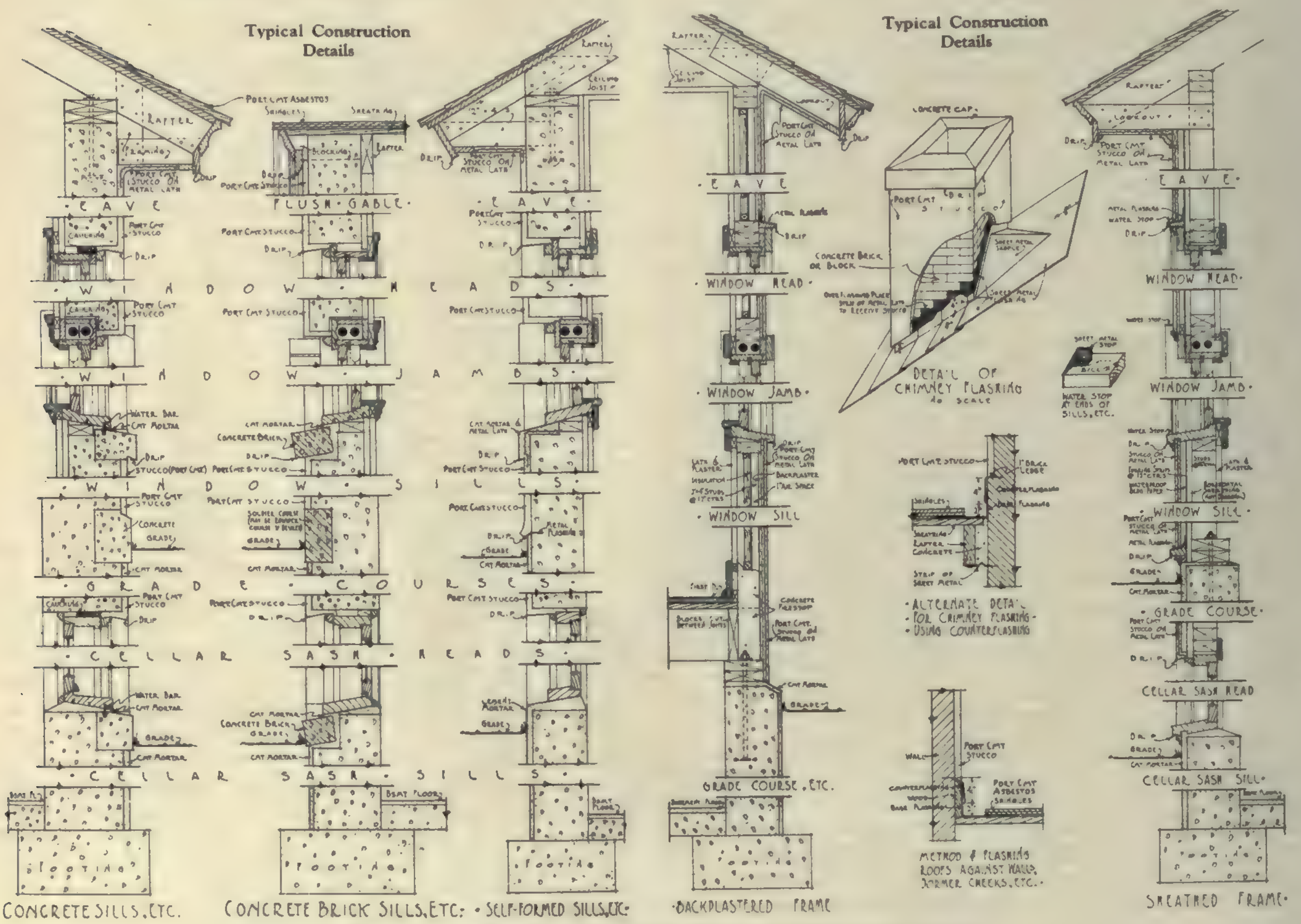
Stippled Finish—A stippled finish is obtained by lightly patting the finishing coat with a brush of broom-straw to give an even, stippled surfaee.

Rough Cast of Splatter Dash—A mixture of one sack of cement to 3 cubic feet of fine aggregate is thrown forcibly against the newly placed finishing surface to produce a rough, uniform texture when viewed from a distance of 20 feet. Special care should be taken to prevent rapid drying out of this finish by thorough wetting down at intervals after the stucco has hardened sufficiently to prevent injury. A variety of splatter dash finish can be secured by using colored aggregate.

Pebble Dash—Before the finishing coat has begun to harden, clean, round pebbles or other material as selected, not smaller than ¼ inch or larger than ¾ inch, previously wetted, are thrown forcibly against the wall so as to embed themselves in the fresh mortar. They should be distributed uniformly over the surface of the final coat and pushed back into the mor-

PORTLAND CEMENT STUCCO

PORTLAND CEMENT STUCCO



Typcal construction details involving the use of portland cement stucco tar with a clean wood float. No rubbing should be done after the pebbles are embedded.

Exposed Aggregate—The finishing coat is composed of an approved, selected coarse sand, crushed marble or granite or other special material, in the proportion given for finishing coats. Within 24 hours after being applied and troweled to an even surface, it is scrubbed with a stiff brush and water. If the stucco is too hard, a solution of one part hydrochloric acid in four parts of water by volume can be used. After the scrubbing, all traces of the acid should be removed by thorough spraying with water from a hose.

Sand Floated—A sand floated finish is obtained by rubbing the finishing coat with a circular motion of a wood float, a little sand being added to slightly roughen the surface. This floating should be done when the mortar hts partly hardened.

Sand Sprayed—A sand sprayed finish is obtained by spraying on with as much force as possible, by means of a long fibre brush or whisk broom, a creamy mixture of equal parts of cement and sand, mixed fresh at least every 30 minutes and kept well stirred until used. This treatment should be applied before the finishing coat has attained its early hardening, that is, within three to five hours. The addition of hydrated lime not to exceed 10 per cent of the weight of the cement in the mixture, will produce lighter shades of finish.

Smooth Finish—The finish coat should contain all the material desired in the finished surface. The troweling of the finish coat should be continued until the desired smoothness and texture is obtained, but should be the least possible to produce this surface finish. Particular attention to proper curing methods is absolutely necessary to obtain the best results with this type of finish.

Sponge Finish—Immediately after the finishing coat has been brought to an even surface, a clean, soft pine float is pressed down onto the surface and withdrawn, care being taken not to separate the surface coat from the undercoat.

Construction Details

An overhanging roof or similar projection is recommended to keep water away from the stucco and prevent dirt marks. Horizontal surfaces exposed to water should be avoided. All exposed stucco surfaces should shed water quickly. Suitable flashing should be provided wherever projecting wood trim occurs and should be continuous on wall copings, corners, rails, etc. Positive means should be provided to keep water from getting behind the stucco. Downspout hangers, gutters and other fixed supports should be in place before applying the stucco.

Masonry Walls—All masonry walls should be thoroughly cleaned free from dust, dirt and loose particles and wetted to such a degree that water will not be absorbed from the stucco.

Concrete Walls—Monolithic concrete walls should preferably be rough and of course texture rather than smooth, for the application of stucco. Such walls may be roughened by picking, hammering with a pneumatic hamer or by an acid wash treatment.

Concrete Block and Concrete Tile Walls—The surface of concrete block to be stuccoed should be rough with coarse texture to increase the bond of the stucco, but the block should be of good quality. Mortar joints should be raked out or cut back at least even with the surface.

Brick Walls—Surface brick to be stuccoed should be rough, hard-burned and of good quality. Mortar joints should be not less than 3/8-inch thick, and the mortar should be raked out for at least ½-inch from the face.

Clay Tile Walls—Tile should be hard-burned with heavy scoring and should be set with exterior faces in line. Joints should not be raked out but mortar should be cut back to surface.

Frame Walls—Stucco on sheathed frame construction is not intended to add greatly to the rigidity of the building. Diagonal bracing should be used at corners of walls and the details of the frame work given attention to reduce the vibration in the structure to a minimum. Bridging should always be used for the back-plastered type for which sheathing is omitted.

Sheathing should be horizontal and not diagonal. It should be firmly nailed to the studs and covered with a good quality tar or asphalt paper with plenty of lap between sheets and at baseboard and flashing.

Table of Colors to be Used in Portland Cement Stucco

Color Desired	Commercial Names of Colors For Use in Cement	Pounds of Color Required for Each Bag of Cement to Secure Light Shade	Pounds of Color Required for Each Bag of Cement to Secure Medium Shade
Grays, blue-black and black	Germantown lampblack*	½	1
	Carbon black	½	1
	Black Oxide of manganese	1	2
Blue shade	Ultramarine blue	5	9
Brownish-red to dull brick red	Red oxide of iron	5	9
Bright red to vermilion	Mineral turkey red	5	9
Red sandstone to purplish-red	Indian Red	5	9
Brown to reddish-brown	Metallic brown (oxide)	5	9
Buff, colonial tint and yellow	Yellow ochre** Yellow oxide	5	9
Green shade	Chromium oxide	5	9
	Greenish blue ultramarine	6	-

*Only first quality lampblack should be used. Carbon black is light and requires very thorough mixing. Black oxide or mineral black is probably most advantageous for general use. For black use 11 pounds of oxide for each bag of cement.

**Should contain not less than 15 per cent of the oxide.

Furring should be 3/8-inch crimped and should be fastened over the sheathing paper directly along the lines of studs with 1¼-inch staples 12 inches apart. Furring should be placed entirely around all openings and around curved surfaces.

Where metal furring for backplastered construction is used it should be stapled to studs at intervals not greater than 12 inches with 1¼-inch by 14 gauge staples. Self-furring lath should be rigidly fastened to the studs with staples.

Metal lath should be galvanized or painted expanded metal weighing not less than 3.4 pounds per square yard, or galvanized or painted woven wire not lighter than 19-gauge, 2½ meshes to the inch and stiffeners at 8-inch intervals.

Vertical laps of metal lath should be at supports and fastened with staples 4 inches apart. Horizontal joints should be locked or butted or tightly laced with 18-gauge galvanized wire. Sheets of metal lath should be folded around the corners and firmly stapled down. Corner beads should not be used.

Additional insulation may be given to back-plastered walls by fastening felt fibre or cork insulating sheets to the studs between the back-plaster coat and the interior finish. A heavy grade of good building paper may be used for this purpose but should be so placed as to leave an air space between it and the stucco.

Old frame structures to be stuccoed should be made strictly sound and rigid before applying the stucco.

Notes on Coloring Pigments

Depth of the shade produced by mineral colors can be secured only by mixing the materials for a longer time than would be required in work in which color is not used. Magnesium fluosilicate has also been used with apparent effectiveness in setting the color in the stucco.

Red oxides of iron produce the most durable red tints. Venetian red should be avoided, as it tends to run and fade. Manganese oxide is probably the best material for black, although a high grade of carbon black or lampblack is generally satisfactory. Common lamp black should not be used.

Fire Hazard in Wooden Bridge Floors

A Report that Analyzes the Existence of a Fire Risk in Bridges with Timber Floors and Suggests Means of Combatting and Overcoming the Danger

During the past few years a number of serious fires have occurred on important bridges and circumstances attending these fires have indicated the desirability of making a detailed study of the situation, in an attempt to bring out the important factors governing the fire hazard in timber bridge construction. With this purpose in mind a co-operative committee was formed representing fire protection, highway bridge construction, lumber, cresoting and the public interest.

An extensive correspondence has been carried on with city, county and state bridge engineers, and with this and information collected from other available sources as a basis the committee submits the following report:

Fire Risk

The existence of a fire risk in bridges having wooden floors must be recognized. An indication of the importnace of this risk is the fact that on some heavily traveled city bridges small fires are of daily occurrence during the summer months[1].

The available evidence indicates that this risk is much less for country bridges than for city bridges and is greater on long bridges than on short ones.

Causes of Fires

On city bridges, fires are most commonly caused by the lodgment of lighted cigar or cigarette stubs in cracks or depressions where chaff and debris have collected. Decayed or splintered material in the floor adds greatly to the fire risk. In the case of country bridges the greatest risk is from forest and grass fires.

Other reported causes of fires are: Sparks from locomotives or steamboats; hot coals dropped by steam rollers, traction engines, tar kettles or other construction equipment; burning waste dropped by street cars; defective insulation of electric wiring, defective bonding of rails and lack of capacity in return feed wires of electric railways; fires in adjacent structures.

Relation of Preservative Treatment to Fire Risk

Creosoted material appears to be somewhat more difficult to ignite than untreated material, but once ignited it creates a fire which is hotter and more difficult to control and which is known by experience to be more destructive than fire in an untreated floor. However, decayed or partially decayed untreated wood is very easily ignited and has been the cause of many fires. The likelihood of fire is increased by treatment which results in excessive bleeding of oil, such as might be caused by the heavy treatment of green lumber. It should be noted that freshly creosoted material is much more inflammable than that in which the treatment is several months old. It is urgently recommended that orders for creosoted material be placed as far as possible in advance of construction and that the material be seasoned for three to six months after treatment.

Where it is practicable to do so, freshly treated timber may be rendered more fire resistant by thoroughly coating the upper surface with sand. The application of sand should be continued as long as there is any bleeding of oil.

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[1] John D. Stevenson, Assistant Chief Engineer of the Department of Public Works, city of Pittsburgh, makes the following statement: "The city has several steel bridges having wooden floors. Some of these are large the hot, dry periods of the summer, fires on these bridges are very frestructures crossing the rivers and are important arteries of traffic. During quent. They are of minor importance only, because we have been successful in extinguishing them before the flames have taken much of a hold. During the last summer, on one bridge fires were a daily occurrence and not infrequently two or three fires occurred in one day."

The annual report of the fire commissioners of the city of Holyoke, Mass., for 1921 states that during the year "the Department responded to 170 fires on the various bridges. The month of June was particularly prominent in this respect, when the department responed to 64 alarms for bridge fires. This epidemic was lessened in the months to follow through the efforts of the board of public works in sending the sprinkler over the county bridges frequently during the day. While the department has been very fortunate in the past in extinguishing bridge fires at a minimum loss, there is always danger of such a blaze getting so much headway as to cause the loss of one of the bridges." In practically all cases, the cause of these fires is stated in the report of the fire commissioners to be cigarette stubs.

Construction

In general it may be stated that tightly laid floors, in which cracks are eliminated to a large extent, are most fire-resistant.

The relative fire risk of various types of floor may be stated as follows, beginning with the most fire-resistive:

(a) Wood blocks on concrete base. This type of floor may be said to have no fire risk.
(b) Wood blocks on plank sub-floor.
(c) Laminated floor of 4-in., 6-in. or 8-in. strips laid on edge and spiked together, with a bituminous wearing surface.
(d) Plank floor with bituminous wearing surface.
(e) Plank floor without wearing surface.
(f) Multiple-thickness plank floor.
(g) Single-thickness plank floor.

Steel joists or stringers supporting floors of any of the above types reduce the risk of rapid spread of fire by reducing the amount of combustible material exposed. Where wood joists or stringers are used the fire risk will be reduced by using heavy timbers for these members. The massing of combustible material renders it less susceptible to ignition and the spread of fire and lessens the probability of serious structural damage before the fire can be controlled, in case fire-fighting means are at hand.

Special care should be exercised in the design of the floor and its supporting structure to avoid ledges or pockets in which trash may collect. The possibility of the accumulation of rubbish on truss members and in floor openings made for the passage of these members should be given careful consideration. In cases where such construction will not interfere with the proper disposal of floor drainage, curbs on timber floors should be constructed with ample clearance between curb and floor so that trash may have an opportunity to blow away[2].

To check the spread of fire lengthwise of the bridge the spaces between stringers, in cases where these rest on the floorbeams, should be filled with tightly fitting diaphragms over each floorbeam. Perhaps the most practicable method is to use wooden diaphragms at least six inches thick, which may be made up of two thicknesses of plank spiked together. Strips or battens should be placed around the edges of these diaphragms to cover cracks due to imperfect fitting or shrinkage.

In cases where limitation of headroom is not a factor, fire curtains of sheet metal extending at least 5 ft. below the bottoms of the joists, and spaced at intervals of about 50 ft., will be of material assistance in preventing the spread of fire. The corrugated asbestos-covered metal as used for siding and roofing of buildings is suggested for this purpose.

Maintenance

Floors, ledges and pockets, and bridge seats should be kept free from street sweepings and other trash.

In the case of country bridges, particularly timber trestles, all underbrush, small timber, drift and debris, underneath and for some distance on both sides of the bridge should be removed. Grass and weeds should be cut in the early fall and drift should be removed after floods. Where the vegetable growth is heavy, chemical weed killers are recommended as being economical and efficient.

Frequent inspections should be made of any conductors of electricity which may exist on the bridge.

Floors should be kept free from splintered and decayed wood.

Provisions for Fire Fighting

For bridges where watchmen or bridge tenders are employed, water barrels, sand boxes or water mains may be employed to advantage for fighting fires. For bridges not under constant supervision the value of any of the above is questionable although sand boxes would probably be most likely to be ready for use when needed.

Water barrels and sand boxes should be covered and the surface of the water in the barrels should be covered with a light film of oil. In cold climates freezing of the water in barrels can be prevented by the addition of a suitable amount of calcium chloride.

When water mains are provided they should have hose connections every 50 ft. and hose reels every 200 ft. In cold climates they must either be protected against freezing or be kept empty with provisions for supplying them with water under pressure, either from hydrants direct or from fire engines.

Watchmen and drawbridge tenders should be provided with at least one 2½-gal. soda-acid fire extinguisher. Where aid may be expected from a municipal fire department, there should be provided some means of transmitting alarms. If watchmen or bridge tenders are on duty, a telephone may be considered as a substitute for the more reliable and satisfactory public box on a fire alarm telegraph system.

Maintenance of the under-structure and the use of fire-fighting appliances will be facilitated by providing under the bridge floor, on each side of each pier and at intermediate points not more than 100 ft. apart platforms constructed of fire-resistive material. Access to these platforms may be secured either by hatchways in the bridge deck or by stairs on the outside of the bridge.

In cases where fire streams from hose and nozzles are available, there should also be provided at 20-ft. intervals, both longitudinally and transversely, openings in the bridge deck to permit the use of cellar pipes, revolving nozzles or similar devices. These openings should be not less than 10 in. in diameter and should be provided with metal covers which can be easily removed but not readily displaced by accident.

Fire Retardant Paints or Treatment

The weight of the evidence, obtained from laboratories which have investigated this subject, is to the effect that, whatever may be expected from future experimentation, there is at present little that can be accomplished in the way of rendering wood fire-resistive by means of a paint coating or other treatment by chemical methods. A paint coating which is not readily combustible may, however, serve to delay slightly the time in which the lumber reaches its maximum susceptibility to ignition. The difficulty with the chemical treatment is that the chemicals will either wash out or, if waterproof, are not fire-resistive.

The investigation having shown that the subject of bridge fire protection is of an importance not previously recognized, the committee desires to emphasize the need for giving consideration to the fire risk in the design of highway bridges. Public officials having bridges in their charge have a clear responsibility in the matter, and the committee desires to call to the attention of such authorities the desirability of protecting bridges by due care in design and construction, by watchful maintenance, and by provision for preventing and fighting fires.

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[2] Thomas J. Wasser, State Highway Engineer of New Jersey, states that prior to January, 1922, the old Raritan River bridge at Perth Amboy was decked with closely laid rough plank flooring and that, to his knowledge, no fires were reported during the life of that floor. The deck was replanked with heavier lumber, surfaced on two sides and one edge, and laid with ½-in. opening. Since that time there have been seven small fires on the bridge and it has been necessary for the department to put on a fire patrol to meet these conditions.

St. John's Big Dry Dock to be Completed Next Fall

F. M. Ross Describes the Progress to the Members of the St. John Branch of the E. I. C.

St. John's magnificent new dry dock, now in course of construction in Courtenay Bay, it is hoped, will be in readiness for a grand opening next fall, so Frank M. Ross, general manager for the St. John Dry Dock and Shipbuilding Company, Limited, informed his guests—about 35 in number—at an informal dinner served on November 7 in the company's cookhouse at East St. John in honor of Fraser S. Keith, general secretary to the Engineering Institute of Canada, who was visiting.

Mr. Ross told his hearers that the great gates for the dry dock were already under construction; that eighty per cent. of the dredging of the channel had been completed and that a portion of the huge pumping equipment had arrived from Scotland.

Alexander Gray, local engineer for the Federal Department of Public Works, during his remarks, praised the company for sparing no expense in constructing a dry dock that would be second to none on the North American continent, while Fraser Keith also congratulated Mr. Ross and the company on the substantial progress that had been made, and threw out the suggestion that when the date for the formal opening was settled, the annual meeting of the Engineering Institute might be held in St. John, in order that engineers from all parts of Canada might be given an opportunity to view a Canadian dry dock development that ranked with the very best in the world.

A. G. Tapley, chairman of the local branch of the Institute, thanked Mr. Ross, on behalf of the members present, for his generous hospitality and for the opportunity afforded to visit the works.

Prior to the dinner, Mr. Ross conducted the party on board the big tug, Margaret K. Hackett, which conveyed the visitors out to the splendid suction dredge—one of the largest and best-equipped dredges in the world. All were loud in their praise of the capacity of the dredge. From there, the party sailed out to the end of the breakwater and then back again, and on landing, adjourned to the cookhouse.

After dinner, the manager took his guests to the immense concrete structure and there, looking down a hundred feet into the basin, the party saw the framework of the great caisson gates in course of erection.

Of the Very Best Design

Proposing a toast to Mr. Ross, Alexander Gray, local engineer for the Federal Department of Public Works, took occasion to remind his hearers of the pains and care taken by the St. John Dry Dock and Shipbuilding Company, Limited, to construct a dry dock second to none on the North American continent. The company, he pointed out, had sent its engineering staff to the various large cities of the eastern United States, including Boston and New York, to study the very latest ideas in dry dock construction. "We shall profit by the mistakes made there," said Mr. Gray.

Careful tests were made of all the material used in the construction of the dry dock and to date, he said, nearly 60,000 yards of concrete had been placed in the gigantic structure, which is rapidly nearing completion. The facilities afforded to the port when the dry dock was ready for use would be of immense advantage to the city. Mr. Gray thanked Mr. Ross for the hospitality accorded him and his staff and then proposed a toast to the host.

In acknowledging the toast, Mr. Ross expressed his pleasure that so many had taken the opportunity to inspect what would soon be one of St. John's greatest assets. He was glad that they had come and had seen for themselves what was being accomplished on a work that had been subjected to such adverse criticism. He wished that the citizens of St. John would show a keener interest in this development and come out and visit the works.

Difficulties had confronted them, he said, and often he and the engineers disagreed quite strongly, and yet, despite these disagreements, all worked toward one end—the very best job possible. He paid a warm tribute to the loyality of his staff and expressed his appreciation for their invaluable assistance.

When he had taken charge he had expected that the work would have been farther advanced at this time than it was, but he hoped sincerely that by the end of next year the development would be in a fair way toward completion. He concluded by again expressing his pleasure that so many had accepted his invitation and sat down amid applause.

E. I. C. May Meet at Time of Opening

Fraser S. Keith, general secretary of the engineering institute, followed and during the course of his remarks expressed the hope that next fall, when the grand opening of the dry dock occurred, a meeting of the institute might be held at a time to coincide with this important event. He had not the slightest doubt that the meeting would be a splendid success and that all the engineers would appreciate the magnificent work being done on the dry dock construction.

"I visited this plant two years ago and I hope I shall see the opening. We appear to be more interested in this work up in Montreal than people living down here," he remarked. He warmly complimented Mr. Ross on the very evident progress made, and closed his remarks by expressing his pleasure on being present.

The Crandall Company of Boston are drawing up plans for the new marine railway to be erected on the north side of the dry dock. The railway will be capable of hauling all smaller vessels, scows and tugs up to 2,000 tons out of the water. Such a plant would be of great assistance to the local shipping interests.

Annual Convention A.C.B.C.I. Feb. 6-9, Chateau Frontenac, Quebec City

A New Joint Filler for Concrete Pavements*

By L. G. Carmick, Chemist
Bureau of Public Roads, U.S. Department of Agriculture

It has often been remarked that the appearance of concrete roads is greatly marred by the unsightly black streaks produced when cracks are filled with bituminous materials. Although in general the bituminous filler serves its purpose satisfactorily as a maintenance material the sharp contrast between the black bitumen and the light colored concrete is displeasing, especially when the markings are extremely irregular. A light colored filler would make the cracks much less conspicuous and would give the road that appearance of uniformity of surface so much to be desired.

Recently a search for such a filler has been made in the laboratory of the Bureau of Public Roads. The qualities desired are that it shall be sufficiently elastic to expand and contract as much as may be necessary, sufficiently durable to withstand the action of traffic, unaffected by water, easily applied, reasonably cheap, and of the same color as the concrete.

A material meeting these specifications was not easily found, though substances having some of the desired qualities were already available. Among substance tested may be mentioned the following: Substances of the general nature of putty; combinations of glue and molasses, such as are used in printing press rollers, but rendered more durable by means of formaldehyde or chromic acid; vegetable oils polymerized by sulphur chloride and combined with a mineral filler; and combinations of vicose with either sawdust or some filling material, a large number of which were tried. None of these met the requirements. It was thought for a time that a satisfactory material had been found in chicle. This was dissolved in gasoline, about twice its weight of whiting added together with the necessary tinting pigments, and the result was a fluid that could be poured into cracks and which hardened with the evaporation of the gasoline But when actually tried it did not withstand the action of traffic; it was too slow in hardening and, furthermore, it was too expensive to be really practicable.

At last, however, something has been found which really seems to possess all the desired qualities. But in making this statement it is necessary to add that practical experiments have not yet gone far enough to make it certain. Further modifications may be necessary when it has been tried out on a large scale and under varying conditions of traffic and climate. At present, on the basis of limited experiment, one is only justified in saying that it seems good.

A Compound of Rubber

The substance referred to is a compound of rubber, petroleum oil and pine rosin and a mineral filler. Crude, unvulcanized rubber is cut with about twice its weight of kerosene or light lubricating oil. This is added to melted rosin and thoroughly incorporated with it. The best proportion between rubber and rosin has not yet been determined. Probably this will depend upon the climate in which the material is to be used, for the compound should be neither too soft in summer nor too brittle in winter. In the vicinity of Washington one part of rubber to twelve of rosin appears to be satisfactory.

It is a matter of some difficulty thoroughly to incorporate the rubber and rosin. Mere stirring does not answer. It seems necessary to knead or pull the mixture when nearly cold, very much as taffy is worked. However, a perfectly smooth, homogeneous mizture can be obtained with patience and industry and one then has an exceedingly sticky, ductile substance of a dark brown color, solid when cold and quite fluid at 110 to 125 degrees Centigrade. While the mixture is fluid twice its weight of "blanc fixe" is added. This brings the color down to a light yellow, and then by the addition of a very small amount of carbon black the color of portland cement concrete can be matched very closely. The "blanc fixe" referred to is precipitated barium sulphate, a white pigment largely used in the paint industry. It is better than ordinary barytes, or natural sulphate, because it is more opaque. So far it has been found to be the most satisfactory pigment for the purpose, as it is unaffected by the highly acid rosin compound and is fairly cheap.

This crack filler can be manufactured at the present time at a cost for materials that should not exceed ten cents a pound. It can be shipped in barrels or other containers as easily as asphalt. It is melted at the roadside in open kettles and poured into the cracks. No delay of traffic is necessary, as it hardens immediately. While the cost is undoubtedly greater than asphalt it is, after all, but a small item in the cost of a concrete road, and the greatly enhanced appearance due to the absence of unsightly black streaks would justify the slightly higher price.

A considerable quantity of the material is now being manufactured for the Bureau and it is intended to give it a thorough test in the near future.

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*From Concrete Highway Magazine.

Canadian Engineering Standards Association Meet

The semi-annual meeting of the main committee of the Canadian Engineering Standards Association was held on November 13, in Ottawa, at the offices of the association, Mr. H. H. Vaughan in the chair. After the transaction of formal business, the secretary reported that the membership of the association as of October 1 was 285, all members taking part in the work of various active committees of the association. Progress reports of the various working committees were presented, and it was announced that the specifications for steel highway bridges, incandescent lamps, watthour meters, wood poles for transmission lines, flexible wire rope and strand for aircraft, and commercial bar steel are well advanced or are ready for publication, that for steel highway bridges being in the press. The specification for flexible wire rope and strand for aircraft was approved for publication.

In conformity with a request from the Secretary of State's department, a formal resolution was passed changing the location of the head office of the association from Montreal to Ottawa.

The personnel of a sectional committee on road materials and construction under the chairmanship of Mr. A. W. Campbell, Dominion Commissioner of Highways, was approved, this committee including representatives of all the provincial highway authorities and having as its principal object the obtaining of

Dominion-wide agreement on nomenclature, definitions and tests for road materials; and co-operating with the committee recently appointed by the Engineering Institute of Canada on road construction.

A request having been received from the American Engineering Standards Committee for co-operation in unifying divergent local requirements for traffic signals on highways, it was decided to request the highway departments of the nine provincial governments, the Board of Railway Commissioners, the Canadian Automoblie Association and other bodies interested in automobile work, the larger cities of the Dominion, the Engineering Institute of Canada, and the railway authorities to nominate members of this committee. The functions of this committee will be to make a survey of present conditions in Canada, prepare recommendations accordingly, and consider these in connection with the draft suggestions to be prepared in the United States and forwarded by the American Engineering Standards Committee.

It was decided to take similar action in connection with a request for the Association's co-operation in connection with specifications for electric overhead crossings, the organizations interested in this case being the Board of Railway Commissioners, the steam and electric railway authorities, the power companies, and various power commissions, the provincial governments, and the various telegraph and telephone companies.

A suggestion from the sub-committee on concrete and reinforced concrete, that action should be taken looking to the preparation of specifications for reinforced concrete poles was approved.

Canada's Foreign Trade

One of the most encouraging features of the commercial situation in Canada at present, is the substantial improvement which has been taking place in the foreign trade of the country. The present period is one in which the leading commercial nations of the world are competing with one another in an effort to widen their markets, and to build up the foundations of their future trade. In this keen international competition, Canada has gradually improved her trade position, until, in the month of August, she surpassed even the Mother Country in trade with the United States. Not only were more Canadian products sold in the United States during the month than those of any other country, but, in addition, Canada was the largest buyer of American goods. The total volume of Canadian-American trade was two million dollars in excess of the trade between Great Britain and the United States, as the following table indicates.

Canadian trade with the United States—August, 1922

Exports	$56,000,000
Imports	32,000,000
	$88,000,000

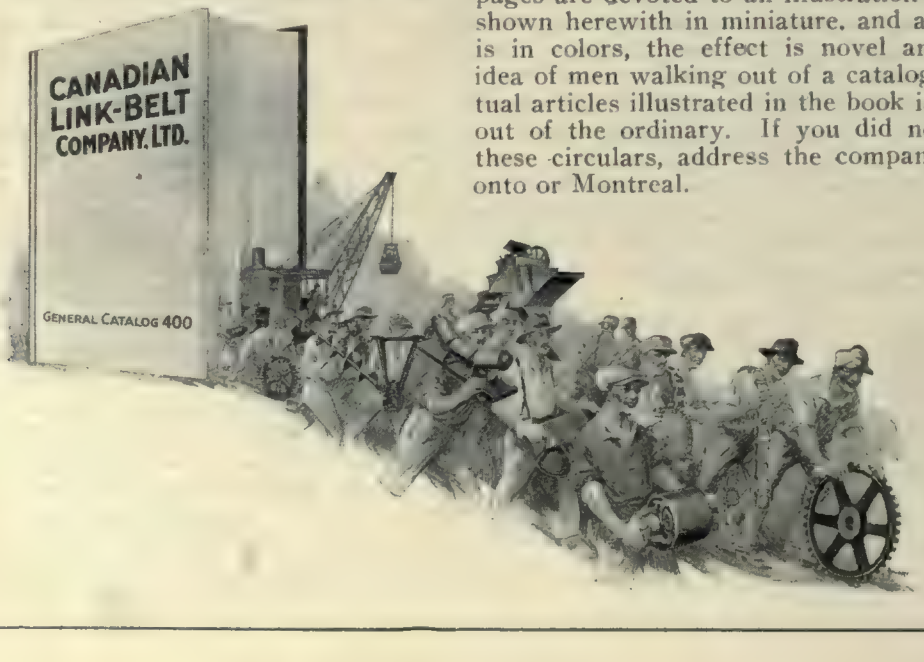
British trade with the United States—

Exports	$55,000,000
Imports	31,000,000
	$86,000,000

The above figures are the more encouraging when one remembers that the improvement in trade has taken place in spite of the increase in the United States tariff. There were many predictions that the new tariff would greatly decrease Canadian exports to the United States. On the other hand, in spite of this artificial trade restriction, and in spite of the recovery of the Canadian dollar, Canada increased her sales to the United States by $8,000,000 over those of August 1921. At the same time, the total value of Canadian imports from the United States was $12,000,000 less than for the corresponding month last year. Nor is the increase in Canadian trade with the United States made at the expense of her trade with other countries. Statistics published by the Department of Trade and Commerce show that there has been a marked increase, during recent months, in the total Canadian foreign trade.

Canadian Link Belt Co.'s New Catalog

A four page circular letter, announcing, the publication of their new general catalog, No. 400, has been received from Canadian Link-Belt Company. This circular carries a letter on the first page suggesting that engineers, superintendents and purchasing agents send for a copy, and provision is made on the last page for eight separate requests. The two inside pages are devoted to an illustration of the catalog, as shown herewith in miniature, and as this illustration is in colors, the effect is novel and striking. The idea of men walking out of a catalog carrying the actual articles illustrated in the book is something quite out of the ordinary. If you did not receive one of these circulars, address the company, either in Toronto or Montreal.



The Contract Record's

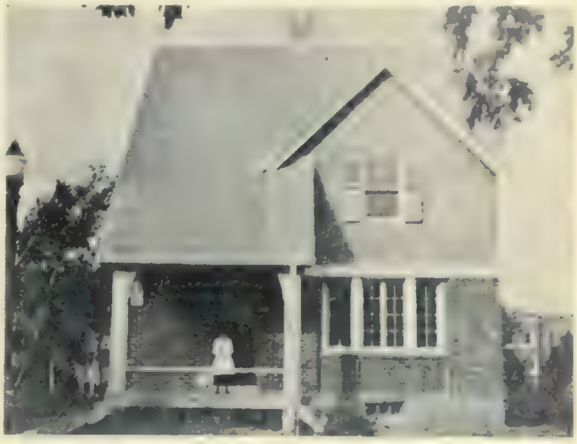
Weekly House Suggestion No. 45

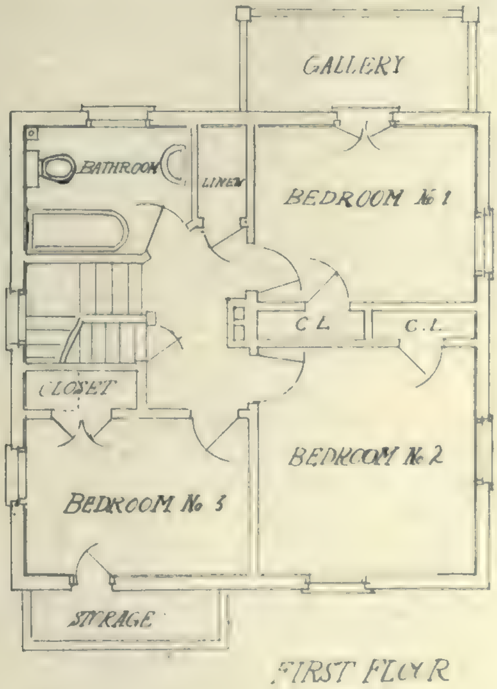
This six-room cottage was designed by Mr. Thos. McLaren, Montreal, architect, and built in that city recently. The exterior construction is 3 inch plank, encased with plastic brick on the lower storey and rough cast above. The shallow bay window in the living room is contrived to avoid bay forms in the concrete foundation wall.

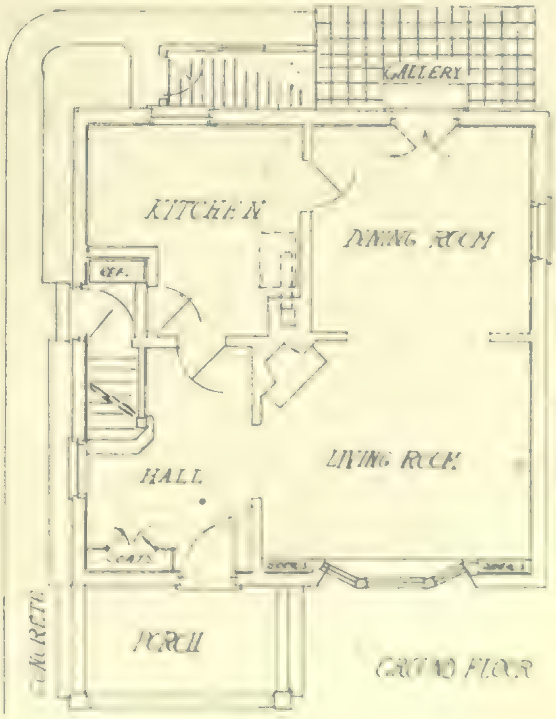
The interior of the ground floor is divided into living room, dining room, kitchen and square hall. There is an entrance at the side, as seen on plan, entering on the kitchen and there is also an opening through double Dutch doors at the rear of the dining room on a concrete platform. The living room, dining room and hall are finished in chestnut, the balance of the house being trimmed with pine, finished white, with doors in B. C. fir, stained. The living room is equipped with built-in bookcases on either side of the bay window at the front and there is also a handsome brick mantel in the left rear corner of this room.

The second floor has four well-arranged bedrooms all thoroughly equipped with linen and wardrobe closets. There is also a doorway from the rear bedroom on a gallery.

The cellar is full size and has an opening to the outside for the convenience of ash removal and wash day purposes. There is accommodation in the basement for laundry, boiler room, coal bins, etc.







The British Industries Fair

The British Industries 1923 Fair, the annual exhibit established in 1915 and held simultaneously at London and Birmingham, will be open from February 19 to March 2. This is the trade buyers annual opportunity of inspecting the products of the Empire's manufacture. It is not an exhibition in the ordinary sense. It is a trade fair to which admittance can only be gained by trade buyers. Everybody at the fair consequently will be there on business and exhibitors and buyers will be able to transact business unhampered by crowds of sightseers. This fair will embody all that is best in British industrial effort.

Mainly Constructional

East and West—From Coast to Coast

The plant of the Stephen Brick Co. Ltd., Prince William St., St. John, N. B., was destroyed by fire recently, the value of the plant and equipment burned being $100,000.

December 20 has been set as the date for the formal opening of the new Mount Royal Hotel, at Montreal. On December 19, according to present arrangements, the hotel will be open for inspection of the general public and the formal opening on the following day will take the form of a dinner, to which several of Canada's most prominent business men will be invited, the dinner to be followed by a dance.

The Ontario Department of Highways has completed this year's construction program and recent figures made public by the department show a total of 300 miles of new roads throughout the province, of various construction, besides a great deal of grading and general upkeep work. The expenditure on this year's work is in the neighborhood of $10,000,000.

Information has been received by the Government from M. M. Mahoney, representative at Washington of the Department of External Affairs, of a decision by the United States Treasury Department to assess duty on cement imported from Canada at the rate of eight cents per 100 pounds. The weight of the package is to be included in the weight for duty. Cement from the United States was provided free entry into Canada under the latest Canadian tariff, but provision was made for the imposition of an equal duty on cement entering Canada in the event of the United States placing a duty against Canadian cement. The rate of the Canadian tariff on imports from the United States, therefore, becomes eight cents per 100 pounds.

A report from Montreal states that work is to be commenced at once on a new grain elevator at the harbor here, for the accommodation of cargo boats. Several hundred men will be provided with employment all through the winter on this project. The total cost of the elevator, which will be equipped with every modern improvement, is estimated at $10,000,000.

The Ontario Department of Public Highways is erecting weigh scales at the junction of Bloor and Dundas streets, Toronto, for the purpose of weighing trucks to find out if they are overloaded. Six hundred and fifty pounds per inch of tire touching the pavement is the maximum loading.

A recent report states that the Price Bros Company, large paper and lumber mill operators, of Lake St. John district, Quebec, are planning to double the capacity of their present huge plant here. Work is to start in the spring.

Damage estimated at between $250,000 and $300,000 was caused by fire at the University of Montreal recently.

The annual re-union and dinner of the Peterborough branch, Engineering Institute of Canada, was held on the evening of Tuesday, November 14, in the Empress Hotel.

Everything is in order to proceed with the construction of the new $350,000 hotel at Sydney, N. S., in the spring. A company has been formed for the financing of the project, with a capitalization of $400,000 and it is anticipated that tenders will be called shortly. No definite announcement has been made regarding plans, but it is stated they will vary but slightly from the original plans drawn up when this project was first broached, which called for a structure of 150 rooms, to be built at the corner of Dorchester St. and Esplanade. It is understood the city is willing to agree on an assessment of $45,000 for a period of 12 years, providing the building is completed by the end of 1923.

Fire did damage to the Sun Brick Company in the Don Valley, Todmorden, Ont., a few days ago, to the extent of $10,000. The fire was confined to the producer house.

An immediate start on the construction of the provincial university buildings in Point Grey municipality, close to Vancouver, will be made by the British Columbia government, according to a recent announcement by Premier John Oliver. Buildings commenced several years ago and partly erected, will be completed as soon as possible. The government will advance the money for the work. The first outlay on construction will be $1,000,000.

Personal

L. J. T. Decary, Esq., architect, has opened offices at 22 Jaques Cartier St., St. John, P. Q.

Mr. T. W. Harvie, chief engineer of the port of Montreal, addressed the local branch of the Engineering Institute of Canada, at a recent meeting, dealing with the story of the development of the Port of Montreal.

Coeur de Lion MacCarthy was the successful contestant in the Verdun war memorial competition, his design being accepted out of 11 submitted. The design is intended to represent Victory and shows a Canadian soldier, wearing full pack, stepping forward, rifle upraised in his right hand and helmet in his left, suggesting a spirit of exultation. The figure will be in bronze on a pedestal of classic design, the face of the shaft bearing the dedicatory inscriptions. Mr. Coeur de Lion MacCarthy is a son of Mr. Hamilton MacCarthy, the well-known sculptor of 377 O'Connor St., Ottawa.

Trade Incorporations

McNiven Bros. Co. Ltd., with head office at Toronto, capital $50,000, to carry on a general contracting business.

The Ontario Construction Co. Ltd., with head office at St. Catharines, capital $50,000, to carry on business as general contractors and builders.

Charter has been granted to Duro Construction Co. Ltd., Room 306, 1 Main St. E., Hamilton, capital $40,000. The manager of the company is Mr. C. Bowser.

Richmond Construction Co. Ltd., with head office at Richmond Hill, Ont., capital $40,000, to carry on the business of building contractors and deal in building materials.

Dominion Portland Cement Company, capital $3,000,000, head office at Montreal, to manufacture and deal in cement and the by-products thereof.

ESTABLISHED 1886

Contract Record
and Engineering Review

A National Journal for the Construction Interests of Canada,
reaching Architects, Engineers, Contractors
Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U. S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 **Toronto, November 29, 1922** **No. 48**

The Early Award of Road Contracts

As in previous years at this time, we are again urging provincial, county and township highway departments to arrange next year's program of road improvements sufficiently early to enable contracts to be let during the winter season. In the last two or three years, much has been done along this line and many of our government bodies are well aware of the advantages that accrue from an early anticipation of their next season's work. Construction for this year has practically ceased and there is now no reason why the programs for 1923 cannot be drawn up. The merits of such a procedure are so obvious that little reference to them should be required.

The winter season is the road contractor's slack time and he will welcome any opportunity to plan his work well in advance. If plans and specifications were available this fall, tenderers would have ample opportunity to look over the ground carefully and make more intelligent bids than if dilatory action on the part of the highways department caused them to delay their tenders until spring. Furthermore, if the awards were made during the winter months, contractors would have ample opportunity to get their organizations in hand before the active construction season opened in the spring. There would then be no delay in starting work and, of course, construction activities would be considerably speeded up. There would then be a possibility of having the road opened during the summer, instead of in the late fall.

Were contractors to know well in advance of the jobs on which they were to work, they would have two or three months advantage in the placing of road materials on the site of the work. In this connection, it is well to remember that the railroad cars are available in greater quantities during winter than at any other time of the year. Many contractors know to their loss that they can never count on an abundance of cars for stone haulage in the summer months and costly delays have been caused by too much dependence on summer railroad transport. The obvious remedy is to do more hauling in the winter months when car congestion is not a factor with which to contend.

Contrast with this the system that is still largely in vogue in government and municipal circles. It is generally April or May before plans and specifications are submitted to contractors and June or later before contracts are awarded. Another month's time is often consumed in getting the contractor's organization together, with the result that so much good weather has been lost that construction is delayed far into the fall and the road cannot be made available for use until the next spring.

The early anticipation of road construction and the early award of contracts will certainly prove advantageous to contractors, economical to provinces or municipalities and helpful to the road user who will not have to endure the disagreeable features of detours and delays throughout the whole season. Indeed, so many are the advantages of early award of road contracts that it is a wonder that highway departments have not more readily taken up the idea.

An Abuse of Professional Services

"Overworking a Willing Horse," is the title which Engineering News Record gives to an editorial which deplores the growing tendency of public bodies to abuse the willingness of engineers to help in matters of common weal. It is in a way a case of taking advantage of good nature and while every encouragement should be given to the engineer's participation in public life, it is very unfair to expect continual gratuitous services, according to Engineering News Record, whose comments in this connections are as follows:—

One of the most encouraging signs of the development of the engineering profession is its growing sense of obligation to the community, but as the public becomes accustomed to this willingness on the part of the engineer to help there seems to be growing also a tendency to abuse it. Particularly is this to be observed on the part of state or municipal authorities, who have before them in the regular routine of their duty many problems of an engineering nature to be solved. When these are obviously specific, such things as the design of a sewer system or the building of a bridge, things that every one knows to be part of the engineer's daily job, they hire or retain an engineer for them and pay him as being worthy of his hire. But every so often they have to decide on questions which have only an engineering tinge or which, in their ignorance of the broad scope of modern engineering, they consider to be in quite another field. At such times they are apt to fall back on the "citizens committee" and appoint thereto engineers on whose shoulders falls all the gratuitous work to be done.

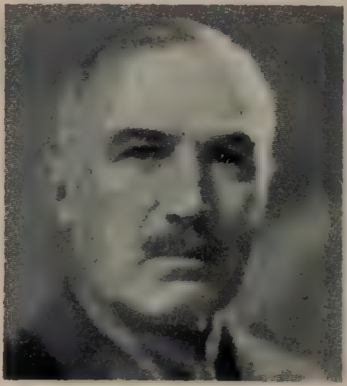
Two such cases have just come to notice. In one

No. 90

Canada's Engineers—Robert Bickerdike

One of Montreal's well known engineers is Lt.-Col. Robert Bickerdike, D. S. O., whose distinguished services during the late war are well remembered. He was born in 1869 and after preliminary education in the common schools and Montreal Business College, took his B.A.Sc. from McGill University in 1891. From the same college he also received the degree of Ma. E. in 1895. His engineering experience began in 1889, as instrument man on the C. P. R. Montreal to Ottawa line. Two years later he became assistant in charge of the McGill College observatory and then assistant engineer on the United Counties Railway. For the next few years he was employed in turn as assistant engineer of the Atlantic & North Western Railway, assistant on the Drummond County Railway extension, demonstrator of surveying at McGill University and assistant engineer on the Montreal Harbor Works. From 1897 to 1904 he was attached to the Department of Public Works and from 1904 to 1908 to the Department of Marine. He was then in 1909 appointed assistant engineer for the National Transcontinental Railway and two years later joined J. H. Hunter, consulting engineer of Montreal. Following two years in this capacity, he was connected with the Canada Starch Company Ltd. on the construction of their plant at Fort William. After the war he was employed again by the Canada Starch Company on alterations and additions to their plants and last year started private practice as consulting engineer.

Colonel Bickerdike was always keenly interested in military affairs and as far back as 1904 was connected with the Militia. On the declaration of war, he offered his services and acted in various important battles, receiving frequent promotion, mention in dispatches and in 1917 the D. S.O., which honor was later augmented by the addition of a bar.



Lt. Col. R. Bickerdike

Colonel Bickerdike is a member of the Engineering Institute of Canada, a member of the Institution of Civil Engineers and a member of the Corporation of Professional Engineers of Quebec.

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state several engineers have been asked to serve on a building code committee made up otherwise of men quite unfitted to give more than perfunctory aid to the technical job of formulating a building code. If this committee succeeds in writing a satisfactory code it will be because the engineers have put in, without compensation, their time and the professional services which are their livelihood. But they will be classed along with the passive members of the committee and will take their reward in such honor as they can find in being named along with vaudeville managers and state labor department employees.

In another state a board composed entirely of laymen and with no technical staff is investigating drainage and backwater problems. In an effort to make some progress in its study the board sent letters to a number of engineers detailing the problem and asking specific advice. The board is now complaining because this questionnaire method has brought only evasive and indefinite replies, not recognizing that engineers rarely have sufficient income to permit much unrewarded professional service and second that no engineer can give a satisfactory opinion without study of facts.

What is the complaint in both these instances? It is not that the engineer is unwilling to bear an equal burden with his fellow citizens in this business of government, nor that he is unwilling to give freely of the fruits of his engineering experience in illuminating the dark corners of subjects outside the strict field of engineering. He does believe, however, that he should not be asked by the state to give that by which he makes a living any more than the butcher should be asked to give beef to public hospitals or a contractor to lay for nothing a stretch of city pavement. Individually he may want to offer his services gratis just as the butcher may want to send meat to the hospital but the former should be considered charity just as surely as the latter is so considered. It should not be a form of public service taken as a matter of course.

Such an attitude on the part of the individual engineer need not interfere with the desirable public activities of the engineering society in the study of public problems nor with the engineer's personal activities in the broader phases of public life. Much good can come both to the profession and to the community by such reports as the New Orleans engineers have just made on the Mississippi flood situation and those made by Washington chapter of the A. A. E. on the Knickerbocker failure. Those reports informed the public on important engineering situations with the authority that group action gives and in a way that would probably not have resulted from retained engineers.

The situation, then, reduces to this. Engineers believe that their habit of work and of thought and the materials with which they work entitle them to a certain respect in matters of public interest. They believe that the business of government would be helped by the consideration of views which they may

(Continued on page 1143)

School Building with Special Features

The Lanigan School is the First Fireproof Rural School in Saskatchewan—Walls Are Concrete and Were Built with Moveable Forms—A Non-Conductive Type of Construction

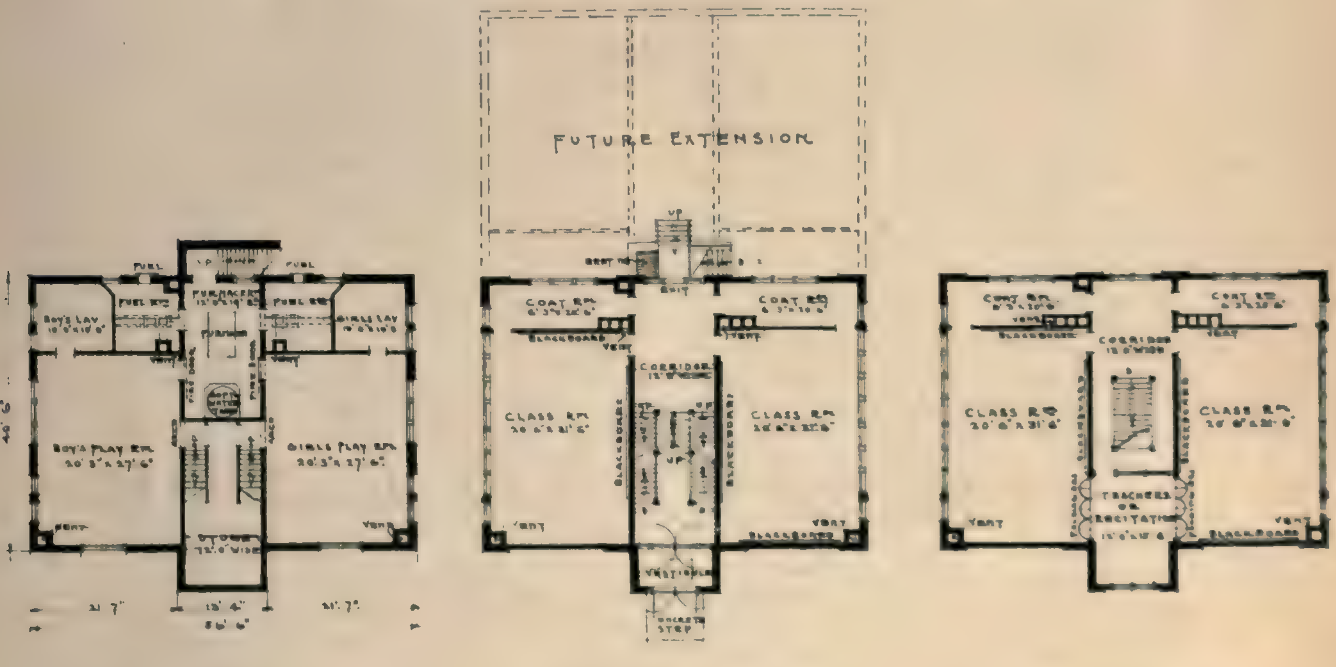
The Lanigan School, of which a plan and illustration appear below, is the first fireproof country school in the province of Saskatchewan, the whole building being constructed of reinforced concrete. The building contains 4 class rooms and cloak rooms, 2 teachers' rooms; 2 play rooms, lavatories, and fuel and furnace room. The two large class rooms on the top floor may be converted into one large auditorium by sliding back the doors in the teachers' room. Provision has been made, as noted by the dotted lines on the plan, for a future extension that will double the present capacity of the building.

The construction comprises reinforced concrete columns, stiffened with 5" reinforced concrete walls, the inside being plastered and the outside being stuccoed over 1/4" Keystone insulation, 1 x 2" furring and metal lath. The floors are 5" reinforced concrete slabs on reinforced concrete beams. The lower side of the floor slab is plastered, while the top is covered with a fir floor on 1 x 2" furring and a layer of 1/4" Keystone insulation.

A modern system of ventilation with proper inlets has been installed and every effort has been made to see that in equipment and layout this school is quite up to standard set for urban institutions.

One of the interesting features in connection with this construction was the use of moveable forms for the building of the walls. These forms and falsework were raised on jacks, after each 3 ft. course of concrete had been poured and allowed to set over night. The forms had attached to them a scaffolding or falsework from wall to wall, on which the men worked and the material was handled. After one day's pour of concrete—about 3' in height—had been allowed to set over night, the forms and falsework were raised on jacks ready for another 3 ft. course. The usual wall thickness is 5 inches and wooden plugs were set in at necessary places both inside and outside walls, as well as iron bed plates for the floors. On completion of the reinforced wall insulation was applied to the outside and over this metal lath was nailed to the plugs. Plugs on the inside were for the nailing of the interior trim. This type of con-

Sketch of Lanigan school



.·BASEMENT PLAN·.

.·GROUND FLOOR PLAN·.

.·FIRST FLOOR PLAN·.

Floor plans of the school at Lanigan, Sask.

struction is said to be very non-conductive and experiments have shown that with hot air heating system and large rooms, a difference of only one degree in temperature is noticeable between the floor heat and the temperature 6 feet up in the room. No storm windows have been found necessary to give added protection in winter time. This same type of construction is being used on other buildings designed by the same architect. Some of these are: Nurses' Home at Kenora; Scott's Dairy at Saskatoon; power house of the Saskatoon City Hospital and the Utility Hospital, Saskatoon. The architect for the Lanigan School was R. M. Thompson, A.M.I.C.E., M.R.I.C.A., of Saskatoon, and the contractors were Messrs. Miners and Ball. The contract price was $24,500.

Wood in Construction of Ice Houses

New Design with Wood Insulation is Practically as Efficient as the Fireproof Storage House with Cork Insulation and the Price is Much Less

By DUDLEY F. HOLTMAN
Construction Engineer, National Lumber Manufacturers' Association
Before the Eastern Ice Manufacturers Association

I suppose it to be beyond doubt that of any assembled company the vastly preponderating majority have only rather vague ideas of the structure or mechanical properties of lumber and structural timber. It is equally beyond doubt that, with the rarest exceptions, few users of wood in construction understand the reason for selecting material possessing certain physical characteristics. Grading rules seem discouragingly complex to all but the few who live with them daily. The occasional purchaser finds the examination for grading requirements very irksome principally because he is not familiar with grading rule language. To supply an antidote I shall endeavor to present a few of the fundamental principles to be observed in selecting structural material from our forests but before doing so I think it will be profitable to consider the reason for using wood at all in the construction of ice storage houses.

Some people seem to be astonished beyond measure in this age of fire-resistive construction when anyone has the temerity to suggest the use of lumber for any kind of building construction. Our fire prevention brethern are hardly through clapping their hands after one group of wood-substitute manufacturers condemns the use of wood in all vertical constructions when "low-and-behold" another group anxious to obtain similar approbation seriously resolves to discourage the use of wood in all horizontal construction. When I know that groups of well informed, earnest men have reached conclusions which rules wood out of all kinds of construction, I naturally approach a topic such as the one assigned to me to-day with no small degree of anxiety.

I gain courage, however, when I read extracts from a report dealing with the general subject of heat transmission which has recently been issued by the magazine "The Survey" of London. This report is based upon a series of experiments on the transmission of heat through surfaces of wall materials which were conducted by the British Building Research Board. The statement is made in the report that when heat is passing through a region of comparatively high temperature through a partition of some kind to a region of low temperature the heat transmitted can be said broadly to depend on the construction and material of the wall, the character of the surface of the wall, the area of the wall, and on the temperature difference between the regions of high and low temperature.

Insulating Properties of Wood

The insulating qualities of wood are pretty generally known, I think, but the figures which I will give will bring home the fact that as a material lumber is very well suited for construction in which low conductivity is an important factor. The relative conductivity of the materials of construction varies quite considerably. For example, assuming the conductivity of silver to be 1.0 (and silver is usually taken as a base in making conductivity comparisons), the conductivity of wood is .003. In other words, lumber, measuring perpendicular to the grain, has about five times as good insulating qualities as cement mortar, or concrete, and five hundred times as good insulating qualities as iron or steel.

Dry well-seasoned wood should, of course, be used, for wet wood is a better conductor of heat than dry wood. This is due to the fact that the conductivity of water, though considerably less than the conductivity of silver, is higher than the conductivity of wood fibre. When wood fibre is saturated with water its conductivity will be greater than it is when the wood fibre is well seasoned and dry. Since dry lumber conducts heat less readily than wet lumber, heartwood is a desirable requirement, especially since from the very nature of things the lumber will be subject to dampness and moisture after it is in place. Conductivity increases also as the density of the wood increases, for the dense, heavy material contains fewer air spaces than the lighter, more rapid growing wood. The increase in conductivity, due to density, is so slight, however, that I would not wish to give you the impression that I recommend the use of light weight material for lumber used structurally in this type of building.

Insulating Properties Depend on Air Cells

In a word, then, the poor conduction qualities of wood are dependent upon its loose structure and upon the air-filled spaces between the solid substance or wood fibre. It is the air that is confined beween the solid matter that makes the transfer of heat slow, not only in wood but in paper, in sawdust, in cork and in wool.

In the first cold storage house for the American

Expeditionary force in France, for the construction of which 4,000,000 feet of American lumber was used, wood shavings were used for insulation of floor, walls and ceiling for it was not deemed feasible to obtain in Europe the necessary amount of cork insulation without causing a delay in the work. The shavings proved to be very excellent insulation, the engine room operating records showing that the amount of refrigeration produced, based on the number of cubic feet refrigerated, was most satisfactory and compared quite favorably with the results obtained in the best constructed plants on this side of the Atlantic.

The great use of wood in ice storage houses is in the frame house of which there are examples all over the country. The old style ice storage house was built by placing 2 x 12 studs on about 18" centers with ⅞" sheathing on both sides as the the wall construction. Sawdust was placed between the studs the full height of the wall. Wooden roof trusses rested upon these walls and carried a wooden roof. The ceiling was made of similar construction using 2 x 8 joists with sawdust between them.

This type of construction, however, has not proven satisfactory for the reason that in an ice storage building where the temperature inside the building is much lower than the temperature outside the building, there is always the tendency for water to condense in the insulation, causing the sawdust to become watersoaked. In a few years the insulation proves worthless. Rot begins on the wood supports, and in a few more years the house is worthless.

New Type of Ice Storage House

Recently a type of construction has been adopted which has proven very satisfactory, in fact, so satisfactory that the wooden ice storage house with wood insulation is practically as efficient as the fire-proof ice storage house with cork insulation and the price is much less. The construction which is used is about as follows:—

2 x 12 studs are used as in the old type of construction but those studs are coated with liquid asphalt. Two layers of sheathing with two layers of waterproofed insulation paper between are placed on both sides of the studs. The insulation which is placed between the studs is more in the form of shavings than sawdust—often the two are mixed. The roof construction, too, is much the same as in the old type construction, with the exception that at the ceiling the shavings are not covered but left exposed. Two layers of sheathing with two layers of insulation paper between are placed under the joists.

With this type of construction, it is not possible for moisture to pass into the insulation and where shavings are kept free from moisture, they are very effective; rot does not occur in the lumber and the life of the building is very materially lengthened. These houses are built from 30 ft. to 40 ft. in height and in widths up to 60 ft. The modern tendency seems to be to have houses built in multiples of 30 ft. in width. With this arrangement, one portion of the house can be emptied without disturbing the ice in the other portion.

It may be interesting, in this connection, to recall that the floors of the first cold storage house erected in France in 1918 at Gieores were supported on large wooden girders carrying joists, the latter being sheaved underneath and then filled with shavings. Over the joists felt paper was laid to keep out moisture and then several thicknesses of dressed and matched lumber with alternate layers of this felt paper were put down. The ceilings consisted of several thicknesses of lumber with air spaces and felt paper and above the ceiling was placed, loosely, about 12 inches of shavings.

Wood Must Be Waterproofed

When using wood in an ice storage house or, for that matter, in any building where cold storage temperatures are maintained, it is very important that wood which passes through insulation be waterproofed in some way. There are many wood preservative compounds on the market, all of which are very good. The use of pure creosote oil is about as effective as any.

Passing now to the phase of the subject dealing with the matter of specifying, I wish to give you a few facts in the hope that they will enable you to appreciate some of the problems involved in ordering suitable structural material.

In order to secure material that is suitable for the framing on the walls, roof, and other portions of the building. it is essential for the purchaser to know something about the characteristics of structural timber. Determination of the most suitable grade of lumber is the most important and perhaps the most perplexing problem to be settled, for the diversity of grades commonly used in commercial practice is very confusing to the average layman.

It is a problem to know whether to order select structural, merchantable, or square edge and sound Southern pine, selected common or No. 1 common, Douglas fir or prime merchantable, or standard pine, from the regions in Florida, Georgia, and the Carolinas, and it is exceedingly difficult for the layman to appreciate the difference between the various grades of common lumber.

But the purchaser is not the only one who realizes the difficulties which present methods give rise to. Lumber manufacturers are keenly alive to the necessity for the development of a simplified, unified system of grading rules, and the whole industry, working as a unit, is now making a very determined effort to develop a grading nomenclature which will make it easier for the uninitiated to purchase lumber. There are, however, many difficulties involved in the preparation of a standard or simplified set of grading rules for lumber and timber. The field is so large and the manufacturing practice so diversified that there would be little hope of making real progress unless the various interests involved showed a disposition to give and take. This disposition seems to be the order of the day. All branches of the industry—not only the manufacturer, but the distributor, the wholesaler, and the retailer—are sitting down at a common council table and discussing this problem of the standardization of grades and the standardization of sizes, and the unification of all of the diverse practices existing in the industry today which are so perplexing to the buyer.

The purpose of grading rules is to provide a logical specification by which the log-run product can be separated into different divisions or grades, so that the product of the mill can be placed at the disposal of the consuming public so divided that the grades which you buy will be those which are best suited to your specific requirements.

Requirements of Structural Timber

Without going into a discussion of the merits of various grades, I should like to speak for a few minutes about some of the basic characteristics which should be given consideration in selecting lumber or timber for structural uses. It has been found from intensive series of tests that the strength of wood depends on density, defects, and moisture, so that it becomes necessary to find some visual method of classifying timbers according to the degree in which they are influenced by these factors. Plotted graphs based upon the results of tests indicate that as the specific gravity or dry weight increases the strength also increases in a fairly uniform manner. Density, however, is a factor that cannot be determined from inspection, so it becomes necessary to find some method of estimating it. This is done by making use of the varying proportion of summerwood (the hard dark portion of the annual ring) and springwood (the light soft portion of the ring) in different timbers.

In tests made on a number of small pieces of summerwood and springwood whittled out separately from wide ringed pieces of loblolly pine, the strength and density of the summerwood came very close to being twice that of the springwood, so that the percentage of summerwood in the annual rings is an indication of weight and strength.

Another point in connection with estimating density from the proportion of summerwood is the contrast in quality between the summerwood and springwood. Numerous tests have shown that in the heavier and stronger material this contrast is sharp, consequently it becomes necessary to draw up the summerwood requirements for high-grade material so that they will include a requirement for sharpness in contrast between summerwood and springwood except in those cases where the proportion of summerwood considerably exceeds the required minimum. The requirements of one-third summerwood in the annual rings has proved from tests and in trials under commercial conditions to give high-grade material, provided that certain requirements as to defects are also considered.

In estimating density from summerwood it would be manifestly impracticable from a standpoint of time for an inspector to consider the whole cross section of large size timbers. It would also be impossible in a large number of cases for him to estimate accurately the summerwood in the outer portions of the piece on account of the fineness of the rings. To get around this difficulty it has been decided, for example, to use the zone including the third, fourth, and fifth inch from the center for estimating the summerwood in Southern pine. This portion of the timber in Southern pine is the most easily measured or estimated, and has proven to be very representative of the entire cross section. In the Douglas fir the distance over which the summerwood percentage is measured is different than it is in Southern pine, due to the nature of Douglas fir growth. A measurement taken over the third, fourth, and fifth inches from the pith in Douglas fir would not be at all representative of the best timber that the fir log contained because the most dense growth in the species occurs ten or twelve inches from the center.

Effect of Knots and Other Defects

The influence of knots, checks, shakes, and crooked grain on the strength of structural timber depends upon the character, the size, and the location of such defects. The most dangerous knots in a beam from the standpoint of strength are those on the lower side near the middle of the span. The next most dangerous knots are those on the upper side near the middle of the span. Knots along the center line of the height of the beam, in general, have but little effect upon the strength. Checks and shakes have greater or less weakening effect according to the proximity to the center horizontal plane due to their tendency to weaken the resistance of the beam to horizontal shear. The effect of crooked grain on the strength depends on its degree, and, like knots, it is most serious when near the center of the beam on the lower side.

The effect of moisture on the strength of small clear test pieces is very marked. In the large timbers ordinarily used for structural purposes, however, the checks and shakes generally introduced in the drying process frequently offset any increase in the strength of the wood itself, so that in any heavy structural material it is not considered good practice to allow higher stress values for dry than for green material.

I shall not attempt to discuss the question of suitable species for lining or insulating purposes more than to say that ash is very suitable for such use because of its high insulating qualities. Cypress is also used extensively because besides having good insulating qualities it is lasting. Brick may also be mentioned as a suitable wood along with cork pine and poplar.

Importance of the Port of Montreal

Mr. T. W. Harvie, chief engineer of the port of Montreal in a recent paper before the Engineering Institute spoke of the harbor development which is virtually the history of this city to metropolitan stature.

Today Montreal is the greatest grain exporting city in the world, and though one thousand miles from the sea, is not only the greatest inland port in the world but at the same time is nearer Europe than any other sea port on the entire Atlantic seabord.

Among some of the newer features of the harbor Mr. Harvie spoke of a complete electric power plant which lights the entire port and from which power could be derived to electrify sixty-five miles of harbor railway terminals, operated by the Harbor Board and which will serve every shed and berth, and provide access to every part of the harbor for all transcontinental railways in the Dominion.

The electrification of the tracks is close to completion, when they will be able to handle 1,800 cars per day.

It is interesting to know that Montreal now has seventh place among the great shipping cities of the world, New York, Liverpool, London, Hamburg, Antwerp and Marseilles in the order named still standing ahead. It is hoped with the addition of the new cold storage plant at a cost of $2,250,000 to the harbor, and the gradual development of the Canadian and the United States West, to which Montreal is connected through a complete system of canal, river, and lake navigation, and through which a correspondingly great increase of shipping is sure to come in cold storage exports, the capacity of the harbor will be able to keep pace and even better her present proud position.

Mr. Harvie, speaking of future developments considered it was time to formulate a new plan, covering a number of years, which could be carried out in a systematic way, as the plans of the past had been completed,

A Contractor's Transportation Difficulties

What Interferes With the Unloading of Cars—How Uncontrollable Circumstances Are Overcome—The "Average Agreement" and Its Advantages and Disadvantages

By HARRY S. ELKINS*

Every shipper is entitled to a reasonable time within which to load or unload a car. The rules of the carrier uniformly allows 48 hours for that purpose. There are, however, circumstances in which it is impossible to release cars in that length of time.

Bunching and Weather Interference

For example, sand and gravel may be frozen and impossible to move by ordinary methods, heating by steam being necessary to put the material into condition for unloading. Also floods or snow make it impossible to reach a car and unload it within the 48-hour period. For detention beyond that number of hours, when due to weather interference, additional time will be allowed where a claim is presented within 30 days after the demurrage bill is rendered and the circumstances are fully set forth and the carrier satisfied as to the truth of the claim. Where the material is frozen and more than 48 hours are required to thaw and remove it, the tariffs provide that a written notice of the frozen condition of the material must be given to the carrier's agent. The bunching of cars by carriers at point of origin, en route, or at destination, and delivery of an unusual number of cars at one time, often make it impossible for the consignee to unload each car within 48 hours. The rules usually provide that, where cars are bunched by reason of delay or irregularity of carriers in filling orders for cars, the shipper will be allowed such free time for loading as he would have been entitled to, had cars been placed as ordered. The consignee will be allowed such additional free time for unloading as he would have been entitled to had the cars not been bunched, except that where, for example, he unloads a car in 24 hours, he is not given credit on another car for the remaining portion of the 48 hours free time—the free time on the next car beginning the first 7:00 a.m. after the preceding car was unloaded.

The Average Agreement

Many constructors are parties to the average agreement. The purpose of that agreement is to permit the cinstructor to use the day he has earned by unloading a car in 24 hours as an offset on a car which he does not unload within the 48-hours or two-day period. In other words, where he unloads a car with 24 hours or one day, when the rules provide two days for unloading, he obtains a credit for one day to apply on a car that is not unloaded in that time. Obviously, the opportunity to earn credits by means of which he may escape demurrage charges is attractive to many shippers. It is an incentive offered by the carriers to obtain prompt return of equipment.

Not Necessarily an Advantage

From the standpoint of the shipper, or consignee, the average agreement is not always an advantage; but to many industries it is practically a necessity. Its efficiency depends upon the circumstances of the particular situation No constructor should enter into the agreement merely because of its credit features. Many industries receive freight in large quantities, sometimes in trainloads, and it would be an impossibility to unload each car within 48 hours. Yet if a number are unloaded in 24 hours, sufficient credit may be obtained to offset the demurrage that otherwise accrue on those cars detained more than 48 hours.

Suppose that there is placed on a switch track for unloading a trainload of material that extends beyond the unloading point, and suppose that, before unloading is completed, a second trainload is brought in. Then the remaining cars must be moved to the extreme end of the yard to make room for the later arrival. Unless the older cars are shifted out, which is a cumbersome operation and frequently not done, demurrage would quickly accrue on such cars under the 48-hour rule; while under the average agreement, credits would probably be earned to offset any possible demurrage. The agreement is a necessity to steel mills, blast furnaces, and other large industries. But where cars are not received in such large numbers the disadvantage may easily outweigh the advantage.

It is doubtful if there are many constructors who receive cars in sufficiently large quantities or whose facilities are such as to warrant being parties to such an agreement. It gives, but it also takes away.

Advantage of No Agreement

Where there is no agreement, weather interference and bunching of cars are accepted as extenuating circumstances and demurrage is waived. But under the average agreement the shipper, if demurrage is to be avoided on cars so detained, must earn sufficient credits to offset the detention. If he has been receiving an average of one or two cars a day and suddenly there is a suspension in deliveries so that he receives no cars and then he receives ten cars in one day, unless he makes unusual efforts, he will find it impossible to avoid demurrage; whereas, if he had not been working under the average agreement, he could have avoided demurrage under the bunching rule. One of the purposes of the agreement was to make it impossible for the shippers, who are parties, to obtain exemption because of bunching and weather inference. Where a consignee's men are prevented by weather conditions from loading or unloading, he can secure exemption, if not a party to the average agreement. It is only where facilities and forces for handling freight are ample under all conditions that it is wise to be a party to the average agreement. Where the space for loading and unloading is not large, the number of cars handled daily is small, and where the men and equipment provided for handling the freight are not capable of sudden expansion and contraction in numbers, being merely sufficient for current needs, the average plan is not attractive. The demurrage rules and the 48-hour period were made with the smaller or average receivers and shippers in mind, and the average agreement is the exception of those rules for the benefit of large receivers and shippers on whom the 48-hour rule would be a heavy burden.

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* In "The Constructor."

Where an unusual period of detention results from the bunching of the cars by the carrier, there is no way to escape paying demurrage under the average argeement unless through unusual exertions sufficient cars are unloaded within 24 hours to offset those detained more than 48 hours. Most receivers are not in position to unload and store material so fast.

A New Clam Shell

Dredging contractors and construction engineers will be interested in a new clam shell which works entirely on one running cable and opens and closes automatically. The inventor, Mr. Edward Woolley, 332 Atlas Avenue, Toronto, a hoisting engineer of long experience, claims that the new equipment will perform 100 per cent more work in a given time than existing types of clam shells. The new device appears to be very simply arranged and in the hands of an experienced hoisting operator will involve no difficulties in operation. The engineer simply winds in the one cable until the bucket is at its dumping height, when he swings around the boom into the dumping position, slacks the cable a little and the bucket discharges its load. He then swings back the boom and begins to lower, the clam shell remaining open until its teeth touch the material to be dredged, when it immediately sets itself for closing. It is said that this clam shell has an especial advantage in under-water operations, inasmuch as the operator cannot close the bucket by mistake before it reaches the material to be raised. The fact that it has one running cable instead of two is obviously an advantage.

Mr. Woolley was lead to study out this invention after considerable experience with dredging equipment of all kinds and a realization of the disadvantages under which many an operating engineer is placed in having to control two levers with one hand while he swings the boom with the other, very often resulting in dumping the material in the wrong place or allowing the clam to close before reaching the material to be raised.

A. Walter Allen, 15 Euclid Avenue, Ottawa, heating and plumbing engineer, reports being very busy. He has heating and plumbing contracts for a residence for T. J. Somerville on Riverdale Avenue; a double residence for J. MacCallum on Pansy Avenue, also a double residence for E. Brouse on Carlyle Avenue.

Wages Current in the Building Industry in Canada, August, 1922

[Rates per hour, as reported to the Association of Canadian Building and Construction Industries, 44 Central Chambers, Elgin Street, Ottawa, Canada.]

	Brick-layers	Masons	Stone-cutters	Cement finishers	Carpen-ters	Plaster-ers	Lathers	Painters	Electri-cians	Sheet Metal Workers	Roofers, Slate & Tile	Struct'l steel workers	Reinf'g steel workers	Plumb-ers	Steam-fitters	Hoisting Engi-neers	Hod Carriers	Laborers
Nova Scotia																		
HALIFAX	.64-1.00	.64	.64	.64	.57	.64	.57	.57	.60	.60	.57	.60	.60	.60	[illegible]	.64	.35-.40	.35-.40
New Brunswick																		
MONCTON	.91	.91	.80	.50	.60	.91	.60	.60	.60	.60	.60	.60	.50	.60	.60	.60	.40	.35
ST. JOHN	.90	.90	.80	.90	.45-.65	.90	Pc.Wk.	.60-.75	.50-.60	.60-.65	....	....	....	.60-.65	.60-.65	.50-.60	.30-.45	.25-.35
Quebec																		
MONTREAL	1.00	.90	.75	.60	.60	.90	.90	.60	....	....	....	....	....	.75	.75	....	.45	.30
QUEBEC	.75	.65	.65	.60	.45-.55	.70	$3.00M	.42-.60	.45-.55	.45-.55	.45-.55	.50-.60	....	.45-.55	.45-.55	.45	.40	.35
SHERBROOKE	.90	.70	.75	.45	.50	.75	..	.40-.60	.40-.60	.40-.50	....	....	....	.40-.60	.40-.60	.50-.60	.30	.25-.30
Ontario																		
BELLEVILLE	.70-1.00	.70-1.00	.90	.75	.60-.65	.75	....	.65	.75	....	....	....	....	....	....	....	.35-.50	.35-.40
BRANTFORD	.90	.90	1.00	.60	.70	....	....	....	....	....	....	....	....	....	....	.60	.45	.35-.40
BROCKVILLE	.90	.90	.90	.90	.75	.90	.65	.65	.75	.75	.75	....	....	.65	.65	....	.40	.40
CHATHAM	1.00	....	....	....	.60-.70	.90	7c yd.	.85	.85	.60	....	....	....	.70	.70	....	.35	.30-.40
FORT WILLIAM	1.00	1.00	1.00	....	.75	1.00	7c yd.	.55-.65	.65-.70	.65	....	....	....	....	....	.90	.40-.45	.35-.40
GUELPH	1.00	1.00	1.00	.60	.77½	1.00	.60	.60	.55	.60	....	....	....	.70-.80	.70-.80	....	.40	.35
HAMILTON	.90	.90	.87½	.50	.75	.90	.75	.62	.75	.80	.80	.70	.50	.85	.85	.75	.50	.40
KINGSTON	.85	.85	.85	.85	.75	.85	.75	.65	.65-.70	.80-.85	.80-.85	.75-.80	.75	.80-.85	.80-.85	[illegible]	.35-.40	.25-.35
LONDON	.85	.85	.87½	.85	.70	.85	.70	.60	.60	.60-.65	.60	....	....	.70-.75	.70-.75	....	.55	.40-.50
NIAGARA FALLS	1.00	....	....	1.00	.80	1.00	6c yd.	.80	....	.75	....	....	....	.80	.80	....	.50	.40
OTTAWA	.85-1.00	.85	.85	....	.70	.85-1.00	....	.65	.70-.80	.75	....	....	....	.80	.80	.70-.75	.45	.45
PETERBOROUGH	.85	.85	.80	.65	.65	.80	.80	.50-.55	.40-.55	.65	....	....	....	.65	.65	.50-.60	.50	.40
PORT ARTHUR	1.00	....	....	.60	.60-.65	.95	....	.60	.60	.60	....	....	....	.85	.85	.75-.80	.45	.40
SARNIA	.85	.90	.65-.70	.85	.70	.85-1.00	5 a 6c. yd.	.60-.70	.60-1.00	.60	....	....	....	.70-.75	.70-.75	.55-.75	.50	.40-.50
SAULT STE MARIE	.95	.95	.95	.60	.70	1.00	.65	.65	.60	....	....	....	....	.90	.90	.65	.45	.40
ST. THOMAS	1.00	1.00	.85	.65	.55-.75	.85-1.00	.85	.55-.70	.60-.75	.60-.75	.75	....	....	.85	.85	....	.45	.35-.45
STRATFORD	.90-1.00	.90-1.00	.90	.50	.55-.65	.90	.55	.50-.60	.60-.70	.60	.55	.50	.50	.50-.70	.60	....	.50-.55	.30-.50
TORONTO	1.00	1.00	.90	.65-.70	.80-.90	1.00	.80-.90	.65-.75	.80	.75	.75-.90	.75-.85	.75-.85	.90	.90	.75-.80	.65	.45-.50
WINDSOR	1.15	1.15	1.12½	1.00	.80	1.12½	1.00	.75	.75-.90	.90	1.00	$1-1.25	.50-.75	1.00	1.00	.85-.90	.50	.40-.60
Manitoba																		
WINNIPEG	1.10	1.10	.95	.70	.85	1.07½	.80	.75	.80	.75	....	.85-.90	....	.90	.90	.85-1.00	.50	.42½
Saskatchewan																		
MOOSE JAW	1.15	1.15	....	....	.80	1.15	8c yd.	.70-.75	.90	.85	....	....	....	.95	.95	....	.50	.40
REGINA	1.00	1.00	1.00	1.00	.75	1.00	6c yd.	.72½	.85	.75	.75	....	....	.90	.90	.70	....	.40
SASKATOON	1.15	1.15	1.00	.65-.85	.75-.85	$1-1.10	6 a 7c. yd.	.70-.80	.70-.80	.75	.75	....	....	.90	.90	.75	.40	.30-.40
Alberta																		
CALGARY	1.15	1.15	1.00	1.15	.90	1.15	$4.50M	.75	.85	.85	....	1.10	.87	.95	.95	1.00	.65	.40-.55
EDMONTON	1.10	....	....	....	.70-.75	1.15	7c yd.	....	....	.90	....	.85	....	.95	.95	....	....	....
British Columbia																		
VANCOUVER	.93¾	.93¾	.93¾	.93¾	.75	.93¾	.75	.68¾	.85	.90	....	1.25	1.25	.90	.90	.70	.68¾	.45-.50
VICTORIA	.87½	.87½	.87½	.60	.62½	.87½	.87½	.75	.87½	.80	.80	1.00	.75	.75-.90	.75-.90	.82½	56¼-65	43¾-50

Better Equipment for the Contractor

Two Viewpoints, Supplementing Those in the Last Issue, as Expressed at a Joint Conference of Contractors and Manufacturers

Repair Parts For Mixers

By M. G. W. Pollock, T. L. Smith Co., Chicago

We have been in the mixing game for some 22 years. In that time, we have adopted a definite policy regarding C. O. D. orders on repair parts. We feel that the man who is ordering that part has to have it as quickly as possible, and we sent it to him and arrange the matter of collection later. Our product is sold largely through agents handling other equipment, carrying a set of parts and equipment. In the case of big jobs, where there are one or two of our mixers on the work, we suggest to the contractor that it would be a good thing to have us make up a set of parts that we think would be most needed, and we send those parts on to the contractor. At the end of the job, if this contractor has not found it necessary to use any of these repair parts, we are always glad and willing to take them back; provided, of course, they are unused parts. This has saved a great deal of money for us, and much grief for the contractor, who otherwise would not get his repair part when he wants it.

We insist that the contractor, in ordering the parts, give us the shop number of the mixer for which he wants parts. As is the case with every other manufacturer who endeavors to keep up-to-date, we have tried to make improvements on our models, and every machine goes through a process of refinement. The difficulty is that there may be a contractor who has a model made ten or twelve years ago. If he does not give us the number, we have to guess which one of the machines he wants the parts for.

Machines Change Hands

Another question is the matter of machines changing hands. If we sell a customer a certain mixer, we have the shop number of that mixer, and a record showing to whom it was sold. If we get a repair order from a contractor who has purchased the machine from some other man, and he says that he has a Smith 21-F model and wants a driving pinion or something of that sort, we have no record of his ever having been a purchaser of a Smith mixer. That makes it necessary for us to go to him and find out.

Every salesman realizes the importance of keeping machines in the field going. We have co-ordinated our repair department and sales department and put them in charge of one man. We realize that in making a sale, unless we give service as well, the sale will not be permanently made, or we will never make another to the same party. In the past, the repair department, which has been in charge of the repair man, always had the inside viewpoint. On the other hand, the sales department man gets out in contact with the contractors and knows their viewpoint, and as a result, the sales department man is the fellow who gets all the grief if the contractor shuts down. The salesman realizes what it means to shut down for a few hours or even a day's time, and he is more apt to take care of the repair part orders and rush them through.

We have always made it a point in our firm to send two repair part catalogs; one catalog goes with the mixer and the second catalog goes with the bill of lading to the contractor; if the catalog on the job is lost, the other catalog may possibly be at hand, and in that way we have two check-ups on repair orders.

Advertising

It has been the policy of the company for 18 years to publish only such data as we could guarantee to be true, and that has been taken from the reports of county engineers or inspectors on various jobs or from the log records of the contractor himself. We realize, as any other manufacturer does, that misstatements of any sort react on the manufacturer in a hurtful way. The manufacturer may sell a contractor once on the basis of an extravagant claim, but he will never do it the second time. On the question of performance records and photographs, it seems to me that manufacturers getting photographs should consider the question of the extent of the use of his machine. Unquestionably photographs are very helpful from the contractor's standpoint. He sees different photographs; he will see how John Jones does his job, with possibly one or two elevations; he will see how the other contractor is doing the work with actual installations; and that cannot help but be of great benefit to the manufacturer for that very reason. In examining the photographs, he will see a new way of handling material, a new way of handling or operating equipment; and we feel that it is the biggest advantage that there is in the use of photographs of machinery in actual performance.

Service and Standardization

By W. G. Hill, Samuel Gamble Co., Erie, Pa.

I think I should tell how the contractor can help the manufacturer instead of how the manufacturer can aid the contractor. It seems that we do not order things correctly or right, and they don't know what we mant when we do order them. I am going to grant the manufacturers that argument, because I know it is true. It is true with almost every highway builder that I have come in contact with, whether large or small. It is a condition that can be easily rectified by a combination of our two interests.

On the question of how the manufacturer distributes his product, I want to give you one thought, based on personal experience. I am absolutely a believer in a branch office. We do not like to deal with a broker or a jobber or agents, unless that agent is large enough to have a branch office and a stock of supplies on hand. Speaking for my own firm, in general, unconsciously we are buying our equipment from the manufacturer who is the nearest to where we live and the territory in which we work. That is an answer to you manufacturers as to whether you ought to have a jobber or a dealer, or how else you ought to arrange it.

The highway program is a new one, the highway contractor is fairly new, and the demands from that division of our big industry have been new and development very rapid. To my mind the manufacturer of road building equipment has not met the equipment situation in the supplying of repair parts, except in a few instances.

The question of the publication of advertising matter is not so much a question of the advertising as of what kind of advertising it is. Just before I left home, I picked up a pamphlet showing that a certain type of equipment had done so much work, not only did it do that much work in Iowa and in Michigan, but did it within 25 miles of where I live. I read the article and took twice the time to find out under what conditions that enormous amount of work was performed by this wonderful piece of machinery. I found that they spent two days getting ready to make this record, were shut down five days afterwards, and it cost $1,100 to rebuild their apparatus.

Ideas That Will Ensure Better Construction Equipment

For Contractors

(a) In opening field offices:
  1. Notify manufacturer of such action.
  2. Advise manufacturer to honor field superintendent's orders.
  3. Advise manufacturer what machinery will be used in this territory.
  4. Get new repair catalogs for all machinery used on the job.

(b) Specify distinctly in all repair part orders, by letters or telegraphs, name and address of home office, number of machines and of part, type of machine, description of part.

(c) Give credit information on subcontracators to facilitate shipments of repair parts.

(d) Help manufacturers' work out improvements on machinery.

(e) Make suggestions on how repair parts catalogs may be saved.

(f) Standardize scope of local and national organization publications.

For Manufacturers

(a) Number all parts.

(b) Place metal tag on machine listing numbers of more important parts.

(c) Send two repair parts catalogs with each shipment of new machine, one with machine and one to home office.

(d) Provide protected place in machine for repair parts catalog.

(e) Supply more information regarding spare parts.

(f) Publish no misleading cost data in advertisements.

(g) Make arrangements to ship all repair part orders same day.

(h) Print all catalogs and other matter standard size for filing.

(i) When in doubt about size or style of part ordered, ship all and allow contractor to return what is not needed.

(j) Ship to job such repair parts as might be needed, and allow contractor to return those not used.

For Both

(a) Adopt standard specifications for: shovels, concrete mixers, steam shovels, locomotive cranes, hoisting engines, grading equipment, road graders, dump wagons, etc., etc.

(b) Adopt standard repair part order card for use in ordering new parts.

(c) Secure standardization of requirements of public works departments of different States.

The Wrong Kind of Advertising

Now, that kind of advertising is wrong. Whenever you say you have a shovel that will work with a one-handed man, or a wheelbarrow that will run without a round wheel, or a mixer or any other type of machine that will do the impossible, it is wrong, and it is not going to sell equipment ten years from now.

I don't believe that the equipment manufacturers will find the contractor unwilling to co-operate with him on photographs on some particular type of work with some particular equipment. So far as our company is concerned, we have co-operated with a number of our equipment people on this very item; but we will not allow the equipment man to send an advertising agent to our company to secure photographs and secure certain records on which he will elaborate and misinform the next man. We are always ready and willing to tell the next customer whether your equipment has been satisfactory or not. In fact, our policy is, if it is satisfactory, we tell him; if it has not been satisfactory, we usually keep quiet.

Standardization Equipment

I know of no field where the standardization of types of equipment is more important than in highway work. While we are standardizing or while we hope to standardize certain types of equipment to a great extent, why should not the contractor and the equipment manufacturer and the highway officials or engineers standardize, too? I know the manufacturers have developed types of equipments that were good in New York State, and they were not any good in Pennsylvania. The real thing that is wrong, in my mind, is that we are not working with you—helping you get that piece standardized, or you are not working with us to help us get some piece standardized, or some type that we haven't found to be satisfactory. If the equipment manufacturer and contractor go to a public official with a No. 1 piece of equipment, I think it can be standardized in not only one state, but in several states.

Fryer & Pont, general contractors, Ottawa, Ont., have contracts for two single $5,000 residences of brick veneer and stucco for G. G. Jones on Grove and Ossington Aves.; a $5,000 stucco residence at Rockliffe Park for Mrs. Menney, and a single residence on Ossington Avenue, costing between $5,000 and $6,000.

The Colonial Art Glass Co., 586 Bank Street, Ottawa, Ont., are supplying two memorial windows to be placed in St. Andrews Church, Buckingham, Que.; a large memorial window for St. Davids Anglican Church, Wales, Ont., also all leaded and art glass windows for the new St. Luke's Anglican Church, Ottawa, Ont.

How Gravel Roads Can be Made Serviceable

The Gravel Road Still Has a Useful Purpose to Serve as a Cheaply Constructed and Maintained Highway for Secondary Traffic—Construction Methods

By C. COYKENDALL
Assistant Chief Engineer, Iowa State Highway Commission

The type of improvement most generally practical for secondary road systems is a gravel surfacing or sand-clay surfacing. It has been found during the past ten years that this type of improvement is in general more economical than waterbound macadam and more cheaply maintained under modern traffic. It, therefore, follows that there is probably no problem deserving of more thoughtful consideration on the part of highway engineers than proper methods of constructing and maintaining gravel and sand-clay roads.

In this discussion no fine distinction will be made between gravel and sand-clay construction. Satisfactory results can be obtained with either gravel or sand-clay construction if available material is used intelligently. Given ideal materials, the construction of any type of road is not a difficult problem. It requires a higher degree of engineering ability to get satisfactory results from the most available sources of material, even though such materials may be generally regarded as of inferior quality, than to require ideal materials without consideration as to the availability of such materials, and the resulting construction costs.

It is extremely difficult to determine where the dividing line between the construction of pavement and the construction of gravel roads should be drawn. There are a number of factors that must be taken into consideration in making this determination. Perhaps it would be well to enumerate some of these factors.

Traffic Considerations

First, and primarily, the amount of traffic which must be handled, either present traffic which the highway is carrying, or the traffic that we can reasonably anticipate will be handled as soon as the road is completed. No one can state with any certainty the exact number of vehicles which a gravel road will handle in a satisfactory manner. All know from experience that there are roads on which the traffic can not be satisfactorily taken care of on such a surface. Likewise all know from experience that there are roads of secondary importance where a gravel surface serves every need of the traffic. Between these two points, however, there are many situations which are not so easily classified.

We have reached the conclusion that where the daily traffic is not in excess of 500 vehicles per day, we can qnite successfully construct and maintain a gravel surface. Where the traffic is in excess of this amount, however, maintenance costs mount rapidly and we are unable to give traffic service that is comparable to the service given by a properly constructed and maintained paved road.

Availability of Materials

Second, availability of materials for gravel road construction and maintenance; also availability of materials for paved road construction and maintenance.

Availability of materials determines in a large measure the economical type of improvement on any road. Where a good quality of gravel is available locally for gravel surfacing work, it is economical to construct and maintain gravel roads under conditions where it would not be economical if all such material for construction and maintenance had to be transported a long distance by rail, thereby greatly increasing the cost of construction and maintenance work. The real measure of the value of any type of road is the cost per ton mile or vehicle mile to the users of the highway. In determining this cost the availability of materials is an important factor.

Relative Usability of the Two Types

Third, the relative usability of the two types of road. In considering usability we must take into account tractive resistance, satisfaction and convenience to the users of the road, and the safety of the road. Often we are justified in paving a road that can quite economically be taken care of by some cheaper type of construction, from a consideration of these factors alone. All have had experience in driving over a gravel road where the surface was in good condition, but the dust was so bad that is constituted not only a nuisance, but an actual menace to traffic. All have seen gravel roads, especially during a long-continued dry spell, where the loose gravel which had accumulated at the sides and on the shoulders constituted a real menace to travel, particularly at night when meeting or passing other vehicles.

Experiments carried on by the Engineering Experiment Station at Ames during the past year show that for truck traffic, a good concrete or brick surface requires 20 to 30 per cent less gasoline consumption per ton mile than is required for a road with a good gravel surface. Similar conclusions were reached in a series of tests carried on a few years ago by Professor A. N. Johnson, now with the University of Maryland. Hence it appears that on account of less surface resistance, actual operating costs to motor vehicles users are less on a good paved road than on a good gravel road, and this with other factors that are measures of the usability of a road are worthy of consideration in determining the proper type of improvement.

The Time Element

Fourth, the length of time that must necessarily elapse before a road can be paved.

It is often economical and expedient to gravel surface a road where traffic conditions will justify pavement in order to provide the travelling public with a usable road until such time as the pavement can be constructed. The building of a system of paved highways, including five thousand to ten thousand miles, is no small undertaking, even after the necessary legislative action has been taken and the necessary funds for financing the program have been provided. It takes time to develop an engineering organization capable of properly handling a large paving program.

It takes time to develop sources of material sufficient to take care of a large paving program. It takes time to develop a contracting organization to do the actual work. The demand of the public is for "usable roads now." Consequently, in many instances, we are justified in producing a large mileage of relatively cheap road which will give road users service during the time that must necessarily elapse before a large mileage of paved roads can be produced.

Legislative Machinery

Fifth, legislative machinery for building various types of road. This is really the meat of the whole situation. We can not build roads except as we are authorized to do so by our state legislatures, and are provided with necessary funds. Consequently where we are not authorized to build paved roads and where funds for financing this type have not been provided, we must build the best type of road that has been authorized and for which funds have been made available.

This discussion up to this time has dealt only with factors covering the selection of the type of improvement. We will assume that we have a road which is to be gravel surfaced, and will give consideration to the details of construction.

Alignment, Grade and Cross Section

In gravel surfacing primary roads the same consideration as to alignment, grade and cross section applies as in the case of paving. There are many miles of our trunk line or primary road system that should probably be gravel surfaced before they are paved. Without doubt, however, the time is not far distant when this mileage should and must be paved. Consequently in building a gravel road we should attempt to determine upon location and prepare a design as to grade, drainage structures, and cross section, which will prove satisfactory later on when the road is to be paved. It is quite generally recognized that the maximum grade for primary roads should not exceed 6 per cent and should be made as much less than 6 per cent as topographical conditions will justify. Horizontal curves should be held as closely as possible to a maximum of 10 degrees. Right angle turns should be rounded with a curve of not less than 200 ft. radius, while a 300-ft. minimum requirement is better. In so far as it is at all possible, the element of danger at railway crossings should be eliminated, either by grade separation or relocations of the highway which will eliminate the crossings entirely. The cross section should provide a minimum from 28 to 30 ft. width between shoulders with ditches at least 2 ft. below the shoulder line, and 4 to 6 ft. out from the shoulder line. A flat bottom ditch at least 2 ft. in width should be provided and back slopes made with whatever slope is required to prevent the ditches from filling.

On secondary roads less stringent requirements can be laid down as to grade, alignment and cross section. Grades and alignment should be the best possible to secure giving due consideration to the amount of traffic the road must carry. The cross section will vary between 20 and 30 ft., the limits depending upon the importance of the road, with substantially the same requirements as to ditches and back slopes outlined above for primary roads.

Drainage

Thorough subdrainage is absolutely necessary to successful gravel road construction and maintenance. It is probably even more essential on this type of construction than on pavement, inasmuch as the road surface itself has so much less inherent strength. Subdrainage can be secured either by the use of tile or by the construction of a grade which will bring the surface of the road well above the ground water limits. In all cases the surface of the road should be at least 2 ft. above the ground water level, and as much more than this as it is practical to secure.

Specifications for materials to be used for gravel road construction should be broad enough to admit any graveling material which by intelligent application can be successfully used in road construction. All localities are not in accord with this, but, as stated heretofore, we believe that it is necessary to utilize to the fullest advantage the materials that are available. The maximum size of stone should not exceed 1½ inches. If this limit is changed, we would recommend decreasing it rather than increasing it. The amount of binder which the material may contain is extremely variable. As a general proposition the less binder that is used, the better. There are comparatively few instances where it is justifiable to haul binder for any considerable distance, inasmuch as substantially the same results can be secured by incorporating the loam, clay or gumbo of the road into the surface as binder.

The amount of material required per mile of road varies, of course, with the type of road being improved. Ordinarily between 1,000 and 2,000 cu. yds. per mile is enough. More material can be added from time to time as a maintenance measure. Consequently it is not advisable to place as a construction measure so much material that it is a serious problem to traffic to combat the material.

Construction Procedure

Gravel road construction work is very readily handled as a contract proposition if the specifications are properly drawn. The construction of the grade and the installation of the necessary drainage structures and tile drainage should not be tied up to the same contract as the gravel surfacing. Neither should maintenance by the contractor over any considerable period of time be required. The items included in the contract should be as few and as definite as possible. In our specifications the contractor bids on the following items: Stripping gravel pits, shaping subgrade preparatory to receiving the gravel, loading the gravel at the pit and hauling it one mile and spreading, and additional half-mile units of haul. The stripping of pits is on a yardage basis with a specified amount of work to be done.

It has been found economical thoroughly to prospect the source of supply before contracts are awarded for gravel surfacing work. From these investigations it is possible to specify with reasonable accuracy the amount of stripping that will be required, also whether or not the material must be screened and oversized material crushed. In the average deposit where there is not a large amount of oversized material, the price bid per cu. yd. for loading includes the removal of oversized material at the pit.

All hauls of less than one mile in length are included in the price bid per cubic yard for loading at the pit, as is also the spreading of the material upon the subgrade. When the haul exceeds one mile and is less than one and a half miles the price bid for each additional half mile haul is added to the unit price of loading. Similarly for each additional half mile that must be hauled the unit bid is proportionately increased. This method has been found more satisfactory and less confusing to contractors than bids based on average yard-mile hauls.

Compacting the Gravel

Before the gravel is dumped upon the road the subgrade should be flat and smooth. The gravel should then be dumped either on the shoulders or in the centre, depending upon the time of year that the work is being done, and then spread the full width of the road. The material in the centre should be spread thinly enough that traffic can travel down the centre of the highway without serious inconvenience, immediately after spreading operations have been completed. We have not found the use of a roller practical in gravel road construction. Our most satisfactory results are secured by allowing the gravel to be compacted by traffic, under continuous and intelligent maintenance. By spreading the gravel so thin that traffic is forced to the centre, the shoulder lines are not destroyed nor is the element of danger to traffic introduced that is present when the gravel is windrowed down the centre and traffic is forced to the shoulder line. As the centre becomes compacted under traffic, loose material from shoulders is worked toward the centre of the road and the road gradually assumes the cross section intended, that is, a thickness of 5 to 7 inches at the centre line shouldering out to a feather edge near the shoulder line.

It is often found during the process of compacting the gravel that the material used is deficient in binding qualities. Usually this difficulty can be remedied by harrowing, plowing or otherwise mixing the material of the subgrade into the surfacing. It is believed advisable, however, to exercise considerable discretion as to the amount of binder used. Traffic should not be seriously inconvenienced by being forced to travel for a long period over a loose gravel road, but if some patience is exercised, both by the engineer in charge of the work and those using the road, it will be found that a more successful road will result from a sparing use of binder.

Immediate Maintenance

Under the construction specifications which have been recommended, it is very difficult to state where construction stops and maintenance work begins. As a matter of fact, it is recommended that the maintenance organization take over the road as soon as the gravel has been placed on the subgrade, spread once and thoroughly mixed. The success of any gravel road is dependent very largely on the maintenance. Consequently, as soon as the gravel has been placed a well organized maintenance crew should be in position to take over the road and give it proper attention through the very important stage that it is being compacted by traffic.

For the gravel roads which we can economically build from material available in Iowa, maintenance by a bituminous mat coat or by the application of bituminous materials is not recommended. Many of our materials have too large a percentage of fine material to make this system of maintenance successful. In fact, representatives of commercial interests primarily engaged in the manufacture of bituminous road materials do not recommend the use of such materials on many of the gravel roads in Iowa. This discussion will be limited to maintenance of gravel roads by methods other than by the use of bituminous materials without in any way entering into the merits of the use of such materials where a different type of gravel is available for the construction work.

Gravel road maintenance divides itself quite logically into two operations: First, the maintenance of material placed during construction, and second, maintenance by applying additional material. Both operations are necessary. We must expect to renew from time to time the material which is lost either by the action of the elements or by gradually being forced into the subgrade. On our most heavily travelled roads the material is from 300 to 500 yd. per mile per year.

Patrol Maintenance

For keeping gravel road surfaces in good condition the patrol system of maintenance is strongly recommended; that is, a patrolman equipped with a patrol blade grader and other incidental tools should have full charge of the maintenance of a certain section of gravel road. The length of this section is dependent upon the importance of the road and the amount of traffic which it carries. For heavily travelled roads ordinarily five to six miles is the maximum which a patrolman can take care of. The surface of a traveled gravel road requires constant attention regardless of weather conditions. The best results in filling chock holes that develop are secured after it rains, but the prevention of the development of chock holes is dependent largely on the care the road receives during the dry weather periods. If a film of loose material can be kept on the surface of the road, it will be found that this film of material really bears the brunt of the traffic and prevents ravelling of the surface of the road. Naturally if a film of loose material is to be kept spread over the surface, continual attention on the part of the patrolman is required, as traffic tends to whip this loose material to the centre and to the shoulder lines.

The efforts of the patrolman must from time to time be supplemented by what is ordinarily styled gang maintenance. The patrolman is not equipped to do heavy work, such as opening ditches or building up the shoulders. It will be found on a heavy travelled road that from time to time an accumulation of loose material has taken place on shoulders and that it is very difficult to get this loose material to pack in the centre of the road. In those cases it is often necessary really to reconstruct the road; that is, the loose material that has accumulated on the shoulders should be forced to the centre of the road, the shoulders built up from material taken from the ditches, and the gravel re-spread from shoulder line to shoulder line. For this work, a 12 ft. blade grader drawn by a tractor is very effective. It will be found in this operation that the material taken from the ditches acts as new binder, and that better success will be had in getting the gravel compacted. Quite often this process should be supplanted by the addition of a maintenance course of material. In fact, this process practically always should precede the adding of a maintenance course of material.

Gravel Maintenance on Earth Roads

We experienced during the year 1921 with a so-called gravel maintenance of earth roads. That is, an earth road that has been properly graded and drained is given a very light surfacing of gravel—approximately 500 cu. yd. per mile. We have not considered that with this much material we have been building gravel roads, but we have been making earth roads much more usable for eleven months, at least, out of every year. The addition of the gravel to the top soil of the road makes the gumbo or heavy clay soil much more easily maintained under heavy traffic. It also makes the surface of the road impervious to ordinary summer rains.

The cost of this kind of maintenance where gravel is locally available is not heavy, and it is expected that on roads where a 500-yd. maintenance course was placed in 1921 an additional 500 yd. will be placed in 1922, and in time we are quite likely to have "maintained" an earth road into a gravel road. Material used for this kind of work should all pass a screen with 1 in. openings. We are much interested in the possibilities of this type of road work.

Conclusions

In conclusion we have these points which should be emphasized in connection with the construction and maintenance of gravel roads:

First, do not lose sight of the importance of this type of construction. For years to come this type of road will undoubtedly constitute the greatest percentage of the surfaced roads that are built.

Second, make the maximum use of available materials. Have your specifications as to materials flexible enough to allow the use of any graveley material which with intelligent construction and maintenance methods can be advantageously used for gravel road construction.

Third, draw the specifications in such a manner that the construction of gravel roads is a readily contractable proposition. Do not require the construction contractor to do a lot of maintenance work for which he has neither equipment nor the experienced organization so necessary for satisfactory gravel road maintenance.

Fourth, do not expect satisfactory results from any gravel road unless thorough and systematic maintenance can be given. A gravel road is no better than the maintenance it receives.

This article is based on a paper presented at the last annual meeting of the Missouri Highway Engineers' Association.

Report on Highway Engineering Education

The following is a report of a committee on "Graduate Work in Highway Engineering and Highway Transport" submitted recently to the Second National Conference on Highway Engineering and Highway Transport Education held at Washington, D. C.

In formulating its report, the committee has had in mind the following fundamental principles governing graduate engineering work.

1. The courses should be designed to prepare students to render the service demanded by our social and industrial life.
2. The work should cover a field, beginning at that point where undergraduate work stops.
3. The time at which the work is given should be such that the largest number possible who desire such training can attend.
4. The curriculum should be well co-ordinated as a whole, yet it should be sufficiently flexible to allow students to make special investigations in subjects in which they are interested.
5. The results of any noteworthy investigations should be made available to other investigators and the public.

It is realized by the committee that the institution offering graduate work in highway engineering and highway transport in keeping with these principles is undertaking a task fraught with problems.

Although there is an overwhelming demand from the public for men trained in highway transport. the industry is undergoing such radical changes that the demand is not fully crystalized. The graduate work therefore must be general in scope and fundamental in character.

The Scope of the Course

Highway engineering and highway transport are attracting individuals from all fields. Some are literary graduates who have no engineering training except perhaps pure science; many are graduates in civil engineering and who have no training in highway transport but usually have come in contact with highway engineering to a limited degree; others are engineering graduates who have not even touched upon highway engineering, while some few are graduate highway engineers who perhaps have had more or less experience in the practice of that profession. Graduate work in highway engineering and highway transport, therefore ,should deal with the fundamentals, as well as advanced professional practice.

To have courses given during the regular collegiate year only would mean that those attending would have to leave their work early in the fall which is usually the busiest season. Although it is desirable to have regular collegiate courses for those who can give up the time to attend, arrangements should be made also to accommodate those who cannot so arrange their time.

Students from active work may desire special instruction in one particular phase of the industry and although he may not be able to attend a course running throughout a semester, he should be able to make the desired specialization.

In view of the foregoing facts, the committee wishes to present the following conclusions for consideration.

1. Fundamental courses in highway engineering and highway thansport which are open for students to take for graduate credit should be offered in the regular semester courses.
2. This same work and further specialization should be given in a series of two or three week courses during which time all effort is concentrated on the subject at hand. Hours credit should be given according to the class-room time spent in each period or on each course.
3. The sequence of courses should be properly arranged so that the subject as a whole is covered logically, and should be arranged in relative series so that a series of related subjects can be taken consecutively without any idle time.
4. A complete collection of text-book and periodical literature on highway engineering and highway transport should be available and outside lectures should be secured from men who are actively engaged in the industry and who are recognized authorities in the phase of the work upon which they are to lecture.
5. The series of courses offered should embrace the following subjects:

Highway engineering:

Highway engineering economics, financing, management, organization and personnel.

Highway engineering theory and design.

Highway specifications, contracts, inspection and jurisprudence.

Grading machinery and operation, and earth and sand-clay roads.

Gravel and broken stone roads, dust prevention and bituminous surfaces.

Brick, cement-concrete, stone block and wood block pavements.

Bituminous macadam, bituminous concrete and sheet asphalt pavements.

Highway materials, production tests and research.

Highway structures.

Highway engineering seminar.

Highway Transport:—

Interrelationship of highway, railway and waterway transport.

American and English highway transport methods.

Highway transport economics and surveys.

Highway transport legislation and traffic regulations.

Mechanism, operation and maintenance of motor trucks, tractors and trailers.

Highway transport management: administration, organization and personnel.

Highway transport costs and record systems.

Highway transport seminar.

6. There should be provided the opportunity to take certain courses to be arranged to meet the needs of any group of students who desire to make worthy investigations in any particular field.

7. State or provincial county and municipal highway departments should co-operate with educational institutions in providing, for graduate students, training and experience in highway engineering and the operation and maintenance of motor trucks.

8. Fellowships should be provided for high grade graduate students by individual, companies, and highway departments.

Structural Steel Used in New Belle Isle Bridge at Detroit, Michigan, Floated into Place

Construction work on the structural steel and concrete cantilever arch bridge for the city of Detroit, Mich., connecting the main land with the city park on Belle Isle has been in progress since last fall and a considerable amount of steel work has been created.

The bridge is about 2,200 feet long overall and consists of arch shaped spans of lengths 74 feet to 135 feet to centre of piers with rise ranging up to about 25 feet for the longest span. Each span consists of two cantilever arms and a short suspended span in the middle.

The steel framework is proportioned to carry its own weight and that of the forms and concrete of the ribs, while the load of the deck structure, pavement, and traffic will be resisted by joint action of the concrete and the steel.

A novel method of assembling and erecting the steel cantilevers was introduced by the contractors. A unit or "umbrella" comprising the steel tower over a pier and the two abutting half ribs is assembled on pile bents at the assembling yards. The tower is first set in place on the central pile trestle and is bolted up complete with its bracing. Next, the preassembled half ribs are swung into place individually, connected to the tower and supported near their outer ends on an outer falsework tower. Eye bar back stays are then connected by their pins on the tower end, and when all are in place are connected pair by pair to the outer pins. Finally the deck framing and bracing are placed and bolted up as no rivetting was allowed at the assembly yard. The unit was then ready for floating down the river to the bridge site.

For floating to the bridge site, two 102-ft. scows were placed transversely under the haunches of the half arch ribs. Two sets of adjustable bents are fitted to the scows and form a support for blocks fastened to the steel ribs. The scows are flooded sufficiently to give a lift of 3 feet. When placed under the ribs they are fitted to the steelwork by the adjustable bents and clamped to same, after which the scows are pumped out. As soon as the steel comes to bearing the bents are fixed to take the load and the pumping continued till the scows lift the steel work clear of the falsework on which it was assembled.

The two scow unit is then allowed to float downstream with the current under control of a tug and tag lines, until the steel tower is directly over the anchor bolts in the piers. The unit is then settled slowly into place by flooding the scows. As soon as the steel is landed the scows are sunk clear, pulled from under and pumped out for return to assembly yard for next unit.

The units of steel work range from 100 to 230 tons in weight. It takes about 10 days to assemble, float and land two units, which makes one arch of the bridge.

The contractors were Greiling Bros., and the Wisconsin Bridge & Iron Company were contractors for the steelwork.

An Abuse of Professional Services

(Continued from page 1130)

have to advance on certain of its specific phases. They are anxious that their fellow citizens have the benefit of those views. They are willing freely to contribute of their time and services to the study and promotion of such activities as cannot be carried on by an engineer engaged in the pursuit of his profession. For professional activities, however, they resent the solicitation of free service as unbecoming the state and unfair to the profession of engineering.

President-Elect Killed in Accident

W. E. Wood, prominent contractor of Detroit, Mich., and Windsor, Ont., was killed Friday night at Saginaw, Mich. Mr. Wood was president-elect of the Associated General Contractors of America.

Tests of Reinforced Concrete in Sea Water

A Thirteen Year Study of the Action of Salt Water on Concrete Has Been Carried Out With the Idea of Determining the Extent of Such Action and the Methods of Overcoming It

By **L. C WASON**

President. Aberthaw Construction Co., Boston, Mass.

Before the American Society of Civil Engineers

In the summer of 1901 the writer was frequently at the Charlestown Navy Yard and observed the build- of Pier No. 1 of concrete. This concrete was mixed so dry that no water showed on the surface when tamped in place. In a few years this pier showed serious defects.

The writer and his associates discussed with various engineers the cause of this early failure. Many reasons were advanced, but no conclusion was reached. We broadened the discussion through the technical press, without obtaining a satisfactory answer. Then we decided to investigate the cause. After extended publicity and correspondence, a series of test specimens, numbering 24, all 16 in. square in cross section by 16 ft. long, were made of various qualities of concrete. Three different proportions of cement, sand and broken stone and three different amounts of water were used. These were made in the first half of January, 1919, and were immersed in the sea at Charlestown Navy Yard the last week of February.

They were suspended so that the top of each specimen was about grade 12½. As the average height of tide is 8 ft. 9 in., there was something over 3 ft. of specimen which would seldom be wet and presumably never immersed, while about 3½ ft. projected below mean low water, or grade zero, and therefore would never be uncovered.

The details of making, and progress reports of their condition have been published in two pamphlets, entitled "Aberthaw Tests on Concrete in Sea Water," issued in 1914 and 1920, a number of articles in the technical press, and most fully described by Captain R. E. Bakenhus, civil engineer, U. S. N., in paper No. 1393, in the Transactions of the American Society of Engineers, Volume LXXXI, December, 1917. Reference is made to these sources for full details. Only such extracts from that data will be made as are necessary to make this paper intelligible.

After 13¼ years of immersion and study, the writer thinks it is possible to make some tentative deductions as to the causes of failure, and how to design future structures so as to be as nearly proof against disintegration by sea water as is possible.

The conditions in Boston Harbor are probably as severe as in any other harbor in the United States. There is considerable tide where the specimens hang under Pier No. 9. They are attacked by waves, stirred up by the wind or the wash of ships; there is chance for a certain amount of abrasion from floating objects; there is freezing from severe northern winters; there is attack fom impurities, chemical or otherwise, present in sea water.

In April, 1914, the Navy put into commission fuel oil pipes on pier 9, adjoining these specimens. Enough oil is spilled on the sea to have heavily coated the specimens from near their tops to low tide. In the opinion of the writer this retards action by the sea, and therefore will extend for a longer period the full result of the sea water test, but it has not entirely destroyed the value of this test.

On May 22, 1922, at low tide, the writer made an examination of the specimens. No appreciable change could be observed from the report of 1920, made by the Aberthaw Co., and published in the pamphlet of that year, referred to above. The order of deterioration is the same as that given by Captain Bakenhus' report of 1917.

Present Condition of the Specimens

Of the 24 original specimens, numbers 19 and 21 have been lost; of the remaining 22, five are in poor condition and may be considered to have failed so far as resistance to immersion in sea water goes. These are Nos. 7, 11, 13, 22, and 23. All were mixed with 1 part cement, 3 sand, and 6 stone. Captain Bakenhus makes nine classes, or degrees of failure. He puts No. 7 in the worst class, Nos. 22 and 23 next to the worst, that is, Class 8, Nos. 11 and 13 are in Class 6. fair condition. No. 7 was mixed dry—the rest wet.

Four others show some deterioration, Nos. 1, 4, 8, and 9. Nos. 1 and 4 are rich proportions, but mixed dry. Nos. 8 and 9 are plastic and wet mixtures, but of lean proportion.

The rest, Nos 2, 3, 5, 6, 10, 12, 14, 15, 16, 17, 18. 20 and 24, are in prety good condition.

On May 24, 1922, specimens Nos. 7, 11, 22, and 23 were removed for testing purposes.

No. 7 was made of three average, normal portland cements, Vulcanite, Alpha, and Giant, in equal parts, thoroughly mixed together and repacked in bags for use in mixing concrete.

No. 11 was made of Blanc (white portland cement), very wet.

No. 22 was made of 9/10 part of the same cement as No. 7 and 1/10 part of hydrated lime, very wet.

When the specimens came out of the water there was about ¼ in. of gummy, sticky adhesion of fuel oil and dirt at the tops, which towards the low water mark became thinner, with harder surface, somewhat glossy.

Below low water there were no signs of oil at all, but the specimens were coated with mussel shells, alive, which showed that the water impurities were chiefly those floating on the surface and not sufficient to kill marine life.

Some of the specimens had in the handling of previous years become cracked as they were taken out of the water, some pieces falling off at the cracks showing a very slight brownish discoloration, which indicated that the oil did not penetrate very deep, or in any volume into these cracks.

Where a fresh fracture of concrete occurred there was no evidence of any penetration of oil below the surface of even the poorest specimens. Discoloration was not more than 1/32 in. deep.

In all these specimens the portions most damaged.

namely, near mid-tide, showed rather disintegrated and soft concrete.

These specimens were taken to the writer's shop. There they were cut to approximately square faces, making the specimens more than twice as long as cross section. The steel reinforcement was cut off by oxyacetylene torch burned below the surface wherever it appeared. The workmen found a noticeable difference in the difficulty of cutting with hammer and chisel Nos. 11 and 23.

Results of Tests

Then they were taken to a stone working plant and faced on a revolving polishing bed to a flat surface resembling terrazzo. By the courtesy of Professor H. W. Hayward, they were crushed in the million-pound testing machine at the Massachusetts Institute of Technology, on June 7, 1922.

The top end of No. 7 was so short and so badly cracked that it was impossible to get a test specimen out of this larger than approximately 8 in. square by 15½ in. long. All the others were full size specimens.

A piece of blotting paper was put under the top bearing of the testing machine on the first specimen, and under both bearings of the remaining specimens. The impression made upon these sheets after tests were completed give an indication of the net bearing area, and character of the bearing. The edges of the specimens were rough and ragged. On some the corners were broken so that it was difficult to obtain the bearing area by direct measurement of the specimen itself.

The writer laid these sheets of blotting paper out on a drawing board and as accurately as could be done by the eye determined the average bearing area of each end. This is an approximate area only, and the writer is convinced that if he has erred, it is in making the area too large, rather than too small, so that the crushing strength per square inch would be, if anything, smaller than the actual.

The testing was simply carried to the point of failure of the specimen. Cracks appeared in a normal, ordinary way longitudinally, and formed roughly two prisms of hour glass shape.

Wherever reinforcing steel was exposed after the tests it appeared bright. The most porous specimen of all, No. 7, was so broken afterward that reinforcing bar was entirely removed. With the exception of three spots about one-quarter inch in diameter which showed rust, the bar was entirely bright. This was from the lower end, which had been permanently immersed for 13¼ years.

A test piece was taken from the top of the top end specimens, and two test pieces, one from the lower corner of the bottom specimen and one from near the centre were taken for chemical analysis. Herbert L. Sherman, a cement chemist, co-operated with the writer in testing chemical and physical analyses of the cement in the making of the specimens, and we wish to acknowledge his hearty co-operation in testing these specimens to see what chemical changes, if any, have taken place.

After a careful and complete analysis of three samples each from specimens Nos. 7 and 23, and a thorough study of the results, Mr. Sherman reports that it is impossible to draw any conclusions and that the result of his chemical analysis is meaningless. Therefore, his figures are not reproduced.

When a workman was breaking specimen No. 11, bottom end, to get a sample of interior, he exclaimed that the concrete was wet. It certainly appeared so, although it had been out of the water fourteen days.

The tests show that the normal mixture of concrete shows as good result as could be expected of any concrete of this mixture and age. It will be noted also that the bottom end of each of the four tests is stronger than the top ends.

Omitting No. 7, where a small sample only could be tested and therefore may not be directly comparable with its own bottom, the other three show a ratio of strength of top to bottom of about 92%, which indicates that there is some common law as to the condition of the concrete when permanently wet as compared with dry.

Condition of a Fish Pier

In 1912 the writer built a fish pier in Portland Harbor. This consists of a wharf supported by concrete piers about 4 ft. square with a heavy floor above forming the wharf platform, on which a fish house was built. Most of these piers were built inside of a cofferdam, were therefore cast dry, and were allowed to set for over a month before being subjected to the tidal action of the sea.

Two rows nearest the shore being out of water, except during high tide and never having immersion of more than about 3 ft., were cast between tides. An examination of these was made on May 25, 1922, when ten years old. All the piers cast within the cofferdam appeared in first class condition. Those cast between tides showed some signs of deterioration below high tide line.

In 1902 a series of specimens was made to test the protection of steel from corrosion by concrete. Concrete was mixed 1:3:6 with the expectation that it would be porous. The blocks were 4 in. square and 12 in. long, and had a ½ in. square twisted steel bar 16 in. long running through the centre and projecting at both ends.

One series of these was immersed in sea water under the auspices of the War Department at Fort Warren and after three years' testing the remainder of the specimens were lost.

The second series was given to the chief engineer of the Metropolitan Sewerage Commission, and were immersed in a trunk sewer. After seven years the remainder of the specimens were lost.

The third set was buried in the ground, always damp, sometimes saturated with water, underneath where a waterspout from the roof of a building dripped. A specimen from this group, after being 20 years in the ground, was removed and split open. In every specimen of all three series, where the cement was in hard contact with the steel, it came out bright. Where there were voids there was rust. When the bars were originally embedded, they were coated with hard rust but no scales. This would indicate that cement will protect steel from corrosion in unfavorable conditions.

Conclusion

While it is not time to draw final conclusions from these series of tests, and while the series is not sufficiently comprehensive to prove a general rule for all cases of immersion of concrete in sea water, we think that some conclusions are now justified, and ought to be helpful to those designing marine structures in the future.

First of all, it appears that the mechanical action of the elements are a much more vital point of consideration than chemical action. Those specimens which were most dense show the least sign of wear today. Those specimens which were built porous, with the expectation that they would soon disintegrate, have done so.

Chemical action must be considered. The specimens made of cement low in alumina, both lean and rich mixtures, are in good condition and lead the series. Those which had foreign ingredients, numbers 22 and 23, of hydrated lime and Sylvester solution, show serious weakness, while on the other hand, one specimen containing 5% of clay as filler to make the concrete dense, is still in quite good condition.

The question of the amount of water used in mixing must be considered.

The condition of the specimens tested by Dan Patch, one of the writer's associates, indicates that those containing 9% to 10% of water are in better physical condition than the very dry or very wet specimens.

In placing concrete in forms, if the workmanship is good, excess of cement and mortar is brought to the surface and produces a skin which resists sea water action very well until abrasion has removed it. The concrete below is not so durable in resisting wear as this skin.

The specimens which are made of the poorer materials which earliest fail, due to tidal action, in their lower portions which are permanently immersed, have proved durable.

An explanation of the reason for the top end showing less strength than the bottom end, may be partly due to the matter of suspension. In order to handle the specimens readily ⅝ in. square steel bars were run the full length through two diagonal corners about 2 in. from the surface. A hole was cored in the centre of the specimen, and into this was grouted a hook with a shank about 3 ft. long, by which the specimen was suspended. The dead weight of the specimen is first carried by the reinforcing bars, and in the upper 3 ft. the load is transferred through the mass of the concrete itself to the hook. This produces some tension in the top member equal to about 100 lbs. per linear inch of specimen in the upper 3 ft. This condition may have produced porosity, or cracks invisible to the eye, through which the specimen weathered. The top end was subjected to annual variations of temperature of probably 100°, and at times to changes of many degrees within a few hours —at times to a film of ice upon the surface, and to a slight degree of abrasion from floating objects in the water.

It seems safe to conclude that if rich concrete is made from a good quality of cement, normal composition, or low in alumina and material is thoroughly mixed, using 9% to 10% of water and placed in the dry with careful workmanship, spading to assume a dense surface, that we can be assured of durability in sea water unless there is a considerable amount of abrasion, in which case it will be a wise precaution to face the concrete within the limits of tidal rise and fall with a protective coating. Below low tide, and above high tide, concrete as above described is a practical, satisfactory and proper building material.

What is The Proper Floor For a Garage

A correspondent who wishes to remain anonymous sends in the following inquiry.

I am tendering on a cement floor for a garage, and the man who is building it is undecided about the specifications. Would you kindly give me your opinion whether you think a two-course floor,—concrete four inches thick, mixed 5-3-1, with finish one inch thick, mixed 2½-1—or a one-course floor about 4½ inches thick mixed about 4½ or 5 to 1 would be best? The building is enclosed and I expect will have some heat.

We offer the following answer. If, out of their wide experience, any of our readers can make suggestions that would be of value to this contractor, we should be glad to hear from them.

Either method properly followed will make a good floor, on the supposition, of course, that a proper foundation is laid. We believe, however, that the double course floor is the better, if it is properly laid, that is, if the second course is placed while the first course is still soft. Just as soon as a workman can walk on the lower course, the upper course should be added, so that the two will consolidate as one course. This probably means an interval of six to eight hours, and where the floor to be covered is large, and the working staff small, it may not be an easy matter to maintain right working conditions. If, for any reason, the base course were allowed to harden, before adding the surface, this would result in a poor floor.

Viaduct Fireproofed With Gunite

A rather novel piece of work was performed recently in connection with the fireproofing of a viaduct over the Denver and Rio Grande western freight yards in Salt Lake City.

A few months ago, sparks from a locomotive set fire to the under side of the wood flooring on this viaduct, and owing to the extreme difficulty of fighting the fire from underneath with trains moving back and forth and standing on the tracks under the viaduct, damage approximating $100,000 was sustained before the fire was extinguished.

The railroad officials decided to fireproof the exposed wood portions of the repaired structure with gunite. The contractors mounted their equipment on a string of flat cars, the gas compressor on one car, the cement gun on another, and so on. All wood surfaces are being covered from below with gunite in this manner, and the string of cars is switched from track to track underneath the viaduct as the work progresses.

Working for Success

A man in London tried to hang himself. All he succeeded in doing was to get a handkerchief about his neck and a little pressure on his throat. But he died just as dead as if he had swung himself from the ceiling. The doctor said he died of fright. The coroner's jury brought in a verdict of death by auto-suggestion. In other words, the man thought he was dead, and so he was dead.

This is fact. Maybe some of us will wake up wealthy some day. If you can think yourself dead and be dead, why not think yourself wealthy, or successful, and be wealthy and successful? No one can be successful without belief in himself, except by accident. Rich uncles do die—but not often—and accidental success isn't worth much. You have to work for it. This applies to an association also. Thinking it to be successful is one thing. It helps. But working to make it so is still better.

Tests for Granite Blocks

How Reliable Information May be Obtained About Paving Setts

By C. D. Pollock before the American Society for Municipal Improvements

In studying the present tests for granite in determining its suitability for paving blocks it may be well to study the history and development of these tests.

At first no tests were made, but the blocks were cut, paved and simply submitted to the service test. Architects had required the tests for crushing strength of granite which was to be used in building construction. Some of the engineers thought that a test should be called for and knowing of the architects' test, they inserted this in the specifications. Various mimimum requirements were used, varying from 15,000 pounds per square inch up to even 30,000 lbs. per square inch. When the minimum requirement was much over 15,000 lbs. it was found that many granites which had proved very satisfactory under the service test for long periods were barred out. A study showed that no very definite relation could be found between this test and the behavior of the granites under the actual traffic conditions. In 1915 this society adopted specifications with tests for impact or toughness and the abrasion test or French co-efficient of wear including minimum requirements for moderately heavy traffic and heavy traffic.

At that time these tests seemed about as fair as any which had been tried, although they were not devised for this purpose. Since then, from observation of results obtained in laboratories and results in the pavements it has been difficult to find much relation between these tests and the actual service test in the streets.

These two tests were designed to measure the relative resistance to impact and wear of broken stone for use in macadam road pavements, and they do not to any great degree fit in with the conditions surrounding the use as paving blocks.

The object of this paper is not to advocate the abandoning of all tests, but to encourage experimental study for the developing of more practical tests by calling attention to the defects of those now used in the testing of granite for paving blocks.

In the toughness test the sample is very small, one inch diameter and one inch high, and great care is necessary in making the sample or there will be wide variation in results. A little carelessness in making the test specimens from the same sample may result in an error equivalent to 25% of the total range of all granites used in the Eastern portion of the United States. This chance for error detracts greatly from the value of the toughness test, aside from the fact that it is a test that does not appropriate the wear conditions in the street.

French Coefficient of Wear

In the test for French co-officient of wear also the error may be as great as 25% of the total range of the granites, due to the method usually used in breaking the test pieces with a hammer which may start incipient fractures and also because of the irregularity of the shapes of the pieces for the test.

The Bureau of Public Roads has developed a machine for breaking out the test pieces by pressure which obviates the fault of incipient fractures and produces more regular shapes, but this cuts down the range of results on the various granites and makes it more difficult to differentiate the various granites.

This test does, however, show whether there is any real disintegration or not. The old idea that discoloration indicated disintegration has been thoroughly exploded. Discolored or "sap" stone may in many cases show a greater strength than the clear stock from the same quarry. Real disintegration will show up in this test and herein lies its chief value in giving the relative strength of specimens from the same quarry, although it is not of much value beyond this in indicating how it will wear when paved in the street.

With the object of improving the present test for French co-efficient of wear for granite block pavements, the laboratory of the Bureau of Public Roads has made modifications in the methods of preparing the test pieces for the Deval abrasion test as previously stated, the samples being broken into small cubical blocks by means of a machine instead of by hand. The machine consists of a 20-ton forcing press such as is used in automobile repair shops for forcing the gears from shafts. This press is equipped with both stationary and movable knife edges and it has sufficient power to break a standard 5-inch granite block. This machine breaks the block into small cubes rapidly and much more accurately than can be done by hand and in addition avoids the danger of starting incipient cracks in the stone. In other words, the test pieces have good, clean, fairly regular faces and are approximate cubes.

Abrasion tests upon these fragments showed a greater co-efficient of wear than the old method, but the result checked much better, although the range in values obtained with the different granites was much more limited than with the hand broken specimens. In order to increase this range, Mr. Jackson tried a modification of the abrasion test which was proposed by Messrs. Scofield, Mattimore and others, as follows: A number of longitudinal slots, each 1/16 of an inch in width, were milled in the abrasion cylinder, and the test was run on granite from 12 representative quarries making two or three tests on each kind of granite. Tests were also run on these same granites using the present method, and the results were compared. The elimination of the dust cushion gave lower coefficients of wear but the maximum variation of check tests was much less. In general, the coefficients of wear were somewhat over two points lower than with the present standard apparatus.

The total number of tests made was not sufficient to draw definite conclusions as to what minimum coefficient should be specified, but the maximum variation in check was sufficiently low to indicate that this was a step in the right direction. It is urged that more tests be made along this line and if they prove as consistent as those already made by the Bureau of Public Roads and several other laboratories, it may be possible to select definite minimum requirements to be used with these modifications in this test which will be an improvement on the present standard so that this test may be much more satisfactory than at present. This test is valuable as a means of proving whether a granite is disintegrated to any extent or not.

Accelerated Traffic Test

Several years ago the Bureau of Public Roads constructed 19 sample sections of granite block pavement from different quarries using different forms of filler and cushion and tested them by an accelerated traffic test which consisted of a machine having a frame carried upon rails which were parallel and on either side of the sample sections of pavement. These rails were supported firmly by concrete stringer or beams which also formed the sides of the pavement sections being tested. The subgrade was natural earth on a side hill having a gentle slope. Upon the subgrade 18 inches of rammed cinders were placed and then 8 inches of portland cement concrete was deposited. On this foundation were constructed the various cushions and the test sections of granite pavement. In the frame of the testing machine were cast-iron discs having a diameter of 4 feet which ran freely in the frame. This frame was drawn back and forth over the test sections by means of a cable. This is the nearest approach to a service test which has yet been devised. However, it was not possible to draw definite conclusions from the results obtained as there was more or less settlement of the concrete foundation, probably due to the large amount of cinders underneath it, and the narrowness of the pavement between the concrete foundations of the rails. It would seem as though some such form of practical test could be devised which would not be so cumbersome or expensive but that the laboratories could afford to use it.

An important point to be borne in mind in devising a better test is not so much how individual blocks will act under the test as how they will act when combined as in a pavement with the usual joint spacing and the different fillers in the joints.

A simple form of accelerated traffic test would be the ideal one and approximations of this are what should be aimed at in securing a more practical test.

In summing up the value of the laboratory tests now used to determine the wear of granites in granite block pavements, the conclusion is reached that the test for French coefficient of wear is the only one of value and the principal advantage of this is to determine if disintegration has progressed sufficiently to render the stone unsuitable for use in pavements, provided the coefficient of the normal clear stock of that quarry is known. The value of this test will probably be increased by using the modifications as were tried by the U. S. Bureau of Public Roads.

In the test for abrasion it would be advantageous to use the percentage of wear directly rather than the French coefficient, as in the lower percentages of wear the equivalent French coefficients change greatly for small percentage changes.

Do Not Favor Foreign Engineers

The St. John, N. B., branch of the Engineering Institute of Canada went on record by resolution at its regular monthly meeting on Nov. 16, as being opposed to the policy of employing alien engineers in a consultative capacity in Canada, when Canadian engineers were available.

The special feature for the evening was an illustrated address by Geoffrey Stead on the Richibucto Cape breakwater. Mr. Stead told of the difficulties confronting the engineers in the construction of its breakwater, the main one being drifting sand. On the completion of the structure, a fine sheltered harbor was made possible and port revenue was greatly increased. Fishing boats from along the coast now used this port, whereas formerly they were forced to draw their craft up on the sand and in stormy weather were forced to stay up during the night to watch their boats. The breakwater was built by the federal department of public works at a cost estimated at $60,000.

Thinks Contractor Not to Blame

Toronto, Ont., Nov. 8, 1922

Editor, "Contract Record,"

With reference to an editorial "Who is to Blame" which appeared in a recent issue of the "Contract Record," you will be interested to know that this company maintains a department of architectural acoustics which specializes in the correction of acoustics in churches, auditoriums and offices.

This science is definitely established and very complete data relative thereto is available. It is possible to tell very accurately the acoustic properties of any proposed auditorium before building operations commence, as it is also possible to correct, in the majority of cases, buildings that are defective in this respect. The subject is one that hardly comes within the scope of the contractor. Most architectural courses today do include this subject in their curriculum; it is, however, a matter for specialized knowledge and there are men available with expert qualifications.

Yours truly,
Canadian Johns-Manville Co., Limited,
John A. Bradley
Mgr. Acoustical Department.

Banking Highways at Curves

According to a recent announcement from the offices of the Permanent International Association of Road Congresses in Paris the British Ministry of Transport has directed its divisional road engineers, to see that local officials in constructing highways in England allow for super-elevation of roadways on corner curves wherever desirable. The action was taken following investigation and recommendations by the British Roads Improvement Association which pointed out the benefits to be gained through banking at sharp curves in the way of safety to traffic. In the event of two vehicles meeting in a curve, it was declared, they could be manoeuvred on a banked curve with more certainty and less risk of skidding. It was also declared that there would be much less wear upon the pavement.

Taylor Stokers

The American Engineering Company of Philadelphia, represented in Canada by the Taylor Stoker Company Ltd., Montreal and Toronto, have issued a beautifully illustrated book containing pictures and descriptions of central station plants using Taylor stokers. The illustrations include many of the largest steam plants on this continent, among them being the Montreal Light Heat and Power Co., and the Dominion Power and Transmission Company.

According to a well-known botanist, seaweed contains a large amount of alcohol. This looks as if the bed of the sea within the three-mile limit in America will have to be thoroughly overhauled.—Punch.

Sectional Committe for Gas Safety Code Announced by A. E. S. C.

Governmental departments, technical societies, insurance companies, manufacturers of gas making and gas using equipment, and employers and employees are represented on a Sectional Committee for Gas Safety Code the personnel of which is announced by the American Engineering Standards Committee.

The agencies which will participate in the development of the Gas Safety Code through the machinery of the A. E. S. C. and under the joint sponsorship of the American Gas Association and the Bureau of Standards are:

American Gas Association; American Institute of Architects; American Society of Safety Engineers; Associated Factory Mutual Fire Insurance Companies; U. S. Bureau of Mines; U. S. Bureau of Standards; Compressed Gas Manufacturers Association; International Association of Industrial Accident Boards and Commissions; National Association of Master Plumbers; National Board of Casualty & Surety Underwriters; National Electric Light Association; National Fire Protection Association; National Safety Council; Natural Gas Association; Underwriters Laboratories; U. S. Department of Labor, and U. S. Public Health Service.

No Prosperity Without Production

There can be no prosperity without production. The worker must know that low production with large profits does not make for the prosperity of either capital or labor. The successful method is rapid and economical production with a small margin of profit. With the worker there must be less idleness and more production.

Public works and railroad contractors have been able in times past to maintain a regular organization, and could do this because of the loyalty and co-operation of their employees. In selling their services to their clients the knowledge of this loyalty and co-operation enabled the contractor to enter into an agreement which he knew he could carry out satisfactorily.

Over specialization of workers has lately hampered the efforts of these contractors; in consequence there has been no benefit to the employer or to the employee. A rapid turnover of labor because of restlessness of employees has added a very heavy expense to construction, on account of the necessity for a constant reorganization of forces due to this unsteadiness on the part of the worker. Through co-operation an effort should be made to eliminate this trouble. The worker must also realize that any effort of the employer to stimulate business through economical production is largely to his advantage, in that it will lessen the amount of idleness which we now have in the building industry.—Chas. H. McAllister, general manager, the Lake Erie Construction Co., Cleveland

Roofs of Western Cedar Save Coal to Owners of Buildings

Roofs constructed of western cedar should have great advantage over those built of other materials according to the Forest Products Laboratories of Canada, Forestry Branch, Department of the Interior. In heating a building covering a large area a great amount of heat is always lost through the roof and a considerable saving in fuel can be effected by making the roof of suitable material. In this respect wood is very suitable and of all the woods which are likely to be used western cedar is probably the best non-conductor of heat. It is obtained in large quantity and of good quality and has the further advantage of possessing a natural resistance to decay even under the most adverse conditions.

E. J. Ryan is Head of Vancouver Contractors

A resolution requesting the C. P. R. to carry their construction work on the new pier was passed at the meeting of General Contractors and Master Builders' Association, of Vancouver, B. C., held on November 8. The following officers were elected: President, Lieut.-Col. E. J. Ryan; first vice-president, J. C. Dill; second vice-president, George Murray.

It was decided to hold monthly luncheons in future, dates to be set by the chairman. A delegation will be appointed to co-operate with city officials regarding the proposed changes in the building by-laws and the association is waiting word from the building inspector on this matter. A delegation is working with Point Grey officials on changes in building by-laws being made in that municipality.

Comparative Statement of Contracts Awarded in Canada

According to Geographical Divisions	Ontario	Quebec	Maritime	Western	Total
October, 1922	$ 12,383,700	$ 5,126,000	$ 520,400	$ 6,240,200	$ 24,270,300
October, 1921	7,888,300	6,473,800	542,900	4,092,200	18,997,200
October, 1920	10,154,800	2,674,400	2,372,900	2,967,400	18,169,500
October, 1919	7,905,600	10,705,500	4,300,900	2,667,300	25,579,300
10 months, 1922	129,971,200	54,305,500	9,674,400	43,966,400	237,917,500
10 months, 1921	93,070,100	55,065,500	7,600,500	48,638,900	204,375,000
10 months, 1920	102,231,700	47,015,100	19,750,500	62,462,500	231,459,800
10 months, 1919	75,026,400	48,361,500	16,957,400	24,038,400	164,383,700

According to Classifications or Types	Residential	Business	Industrial	Engineering	Total
October, 1922	$ 8,794,600	$ 6,065,000	$ 3,221,500	$ 6,189,200	$ 24,270,300
October, 1921	7,214,900	5,014,900	1,616,600	5,150,800	18,997,200
October, 1920	4,362,500	5,279,000	6,849,500	1,678,500	18,169,500
October, 1919	4,923,200	7,665,900	11,319,200	1,671,000	25,579,300
10 months, 1922	89,810,400	67,429,700	22,489,200	58,188,200	237,917,500
10 months, 1921	64,666,200	76,432,400	14,868,900	48,407,500	204,375,000
10 months, 1920	50,230,800	79,652,200	61,871,600	39,705,200	231,459,800
10 months, 1919	39,798,800	51,270,500	48,578,100	24,735,300	164,383,700

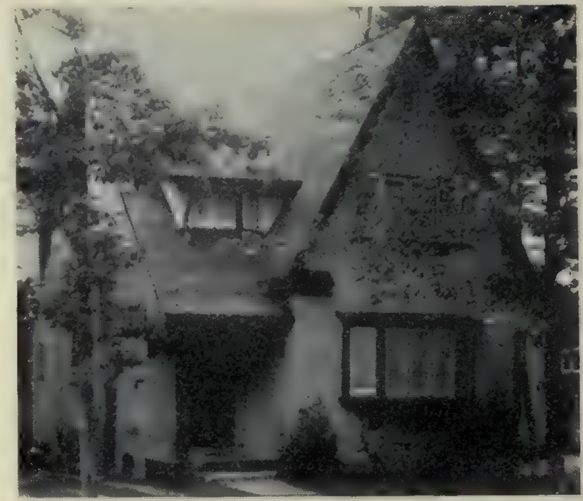
The Contract Record's

Weekly House Suggestion No. 46

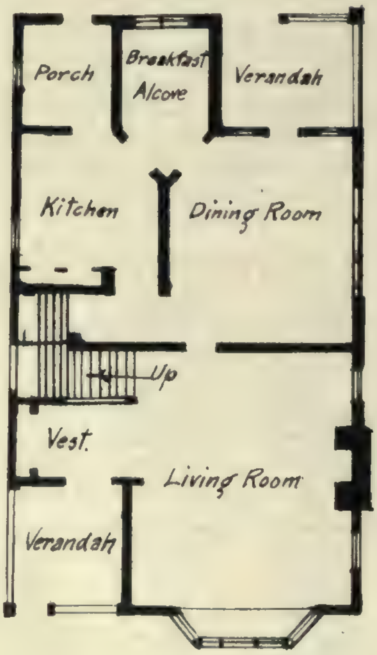
This quaint little residence is situated on McLean Avenue, in the Beach district of Toronto, and is another of Mr. H. Addison Johnston's well designed, better-class homes. The exterior construction is of a rough finished stucco, and the foundations are of brick. The long, sloping roof is covered with stained wooden shingles and harmonizes with the wood trim, which is finished a dark brown. The many window openings are finished on the outside with a flat white, and show up well against the dark trim. A pleasing feature at the front of the house is the small square entrance porch.

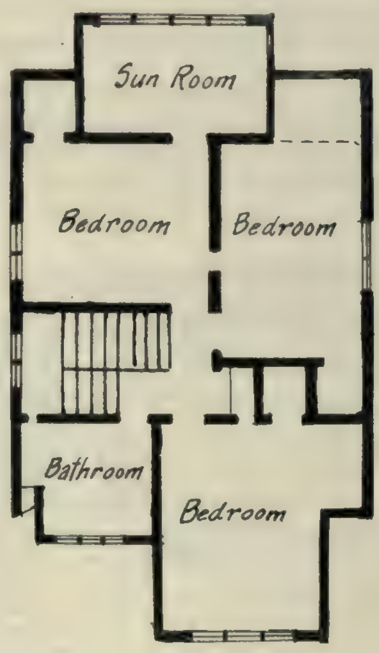
The entrance from the front is on a vestibule, which in turn opens directly on the large living room. This room is the feature of the downstairs layout. It is equipped with a beautiful brick fireplace in the side wall, with a small window on either side. Direct entrance on this room from the side may also be had, as seen on the plan. The dining room and kitchen arrangement is ideal in this layout. The former is a large bright room with direct entrance on rear verandah, breakfast alcove and kitchen. The kitchen is situated handy to the side entrance and is equipped with many built-in service details. There is a small enclosed porch to the rear of the kitchen, with entrance from the rear. The flooring throughout is of oak and the trim is hardwood, finished in white enamel in the kitchen and breakfast alcove.

There are three roomy bedrooms, sunroom and bathroom on the second floor. The rooms are all well arranged and are well equipped with linen closet and wardrobe space.



There are laundry, large boiler room, coal space and fruit celler in the basement. Mr. H. Addison Johnston, home specialist, of 13 Silverbirch Ave., Toronto, designed and erected this house.





English Road Practice

That main trunk highways should have a minimum width at least of twenty-four feet is the opinion of English engineers according to a recent report by Frederick C. Horner, formerly transportation engineer of the Packard Motor Car Company, now investigating transportation conditions in the British Isles and on the continent.

"In England, the best types of road are held to be asphalt and tar macadam. The foundation of the former is generally constructed of the old road bed material minus the worn out top. On this foundation is laid about two inches of bituminous concrete on which is put about 1.25 inches of sheet asphalt. The tar macadam road is a slag tar macadam. Granite was tried but found unsatisfactory."

Mainly Constructional

East and West—From Coast to Coast

Among the permits issued during the past few days at Toronto was one for a 10 storey, brick and tile office building, to be built by Messrs. Robert Reford & Co., of that city, at an estimated cost of $350,000. The building will be located on the northeast corner of Bay and Wellington Streets.

The steel work on the new Chateau Frontenac addition at Quebec has been completed and the brickwork, at this writing, has but three storeys to go. The work has made rapid progress during the past few months, the C.P.R. being particularly anxious to have the structure ready before the height of next summer's busy tourist season. A staff of 550 men, the largest on the contract to date, is at present employed.

The sum of $50,000 will be spent by the province of British Columbia on a survey of iron ore resources of that province, under the provisions of a bill introduced in the Legislature a few days ago by the Minister of Mines, to ratify the agreement between the province and the Dominion to carry on jointly this work.

Contract for the superstructure of the proposed new bridge structure between Ile Perrot and Vaudreuil was awarded to the Dominion Bridge Company recently, at $124,768. The Dufresne Construction Company received the balance of the contract in connection with this structure, at $135,140.35.

P. H. Secord & Sons Construction Co. Ltd., of Brantford, were awarded the contract for the erection of the new city hall at Kitchener, Ont., recently. The firm's price was $253,000 which included the general contract and the stone, which was quoted at $78,500.

The Stephen Brick Company, Ltd., of St. John, N. B., commenced rebuilding their plant at Little River, near St. John, a few days ago. This plant was destroyed by fire recently.

Standard Steel Construction Company, of Welland, Ontario, are making arrangements for the purchase of a site on which they propose to establish a steel construction plant. The new factory will be operated under the name of La Cie de Construction de Quebec and will manufacture steel for the erection of bridges, buildings and ornamental steel work. The site chosen is situated in Limoilou Ward near the junction of the Quebec and Lake St. John Railway and the Canadian National on the Charlesbourg Road.

Fire losses in Canada during the week ended November 15 are estimated by the Monetary Times at $547,500 compared with $231,100 the previous week.

The Engineering Society of the University of Toronto held its thirty-third annual banquet recently at Hart House. The toast to the university was proposed by R. G. K. Morrison, '23 and was responded to by Prof. A. T. DeLury, dean of the faculty of arts.

The payment of $200,000 by the Dominion Alloy Steel Corporation to the Sarnia Indians was made recently on account of the purchase price of the reserve land sold to the company as a site for their proposed huge steel plant.

A recent report states that a terminal elevator costing approximately $850,000 and a capacity of 1,500,000 bushels, will be erected at Port Arthur by James Stewart, president of the Maple Leaf Flour Mills.

Personal

Mr. B. G. Dean, formerly with the Johns Manville Co. Ltd., at Toronto, is now associated with W. A. Moffatt Co., 86 Don Esplanade, contractors for roofing, sheet metal work and insulate flooring.

E. R. Rolph, Toronto, architect, has been elected an Associate of the Royal Canadian Academy.

Col. S. P. Biggs, has been appointed by Order-in-Council to the post of solicitor to the Highways Department of Ontario.

Mr. George A. McCubbin, engineer, of Chatham, Ont., has been appointed by the provincial Department of Public Works, to supervise the Nottawasaga River survey. He will report on the approximate cost of a scheme to dredge and lower the river to reclaim some 20,000 acres of low-lying land damaged by river floods.

Messrs. Sloan & Harrison, building contractors of New Westminster, B. C., have dissolved partnership. The business will hereafter be carried on by Mr. H. W. Harrison, under the old name, Sloan & Harrison.

Alfred G. Noseworthy, architect, has opened offices at 187 Bleury St., Montreal.

Obituary

Mr. George Madden, prominent Quebec road contractor, died recently in that city. Deceased, although 84 years of age, was actively engaged in business up till a few days before he died. Mr. Madden had been in business as a road contractor and coal dealer for the past 40 years in Quebec.

Trade Incorporations

Les Constructeurs de Ponts de Quebec, Ltee., with head office at Quebec, capital $148,500, to carry on a general contracting business, specializing in bridge structures.

Citadel Construction Co. Ltd., with head office at Quebec, capital $150,000, to carry on a general contracting business.

Albert Kahn, Ltd., with head office at Fird City, Ont., capital $25,000, to carry on the business of structural, civil and mechanical engineers, architects and quantity surveyors.

Minogue Trucking Company, Ltd., with head office at Montreal, Capital $50,000, to carry on the business of road and building contractors.

Northern Granite & Rock, Ltd., with head office at Toronto, capital $40,000, to carry on a quarrying business.

Crowland Brick & Tile Co., with head office at Welland, Ont., capital $40,000, to manufacture and deal in brick, terra cotta, tile, etc.

CONSTRUCTIONAL ACTIVITY

Period of Nov. 8 to Nov. 14, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Burlington, Ont.
Town Council contemplate construction of storm sewers on Water St. MacKay & MacKay, Engrs., Home Bank Bldg., Hamilton.

Elora, Ont.
Town Council contemplate construction of permanent pavement.

Grand Mere, Que.
Laurentide Co. Ltd., contemplate construction of concrete and macadam blvd. costing $20,000 from Grand Mere to Ste Flore. Mr. Wardle, Engr.

Gravenhurst, Ont.
James, Proctor & Redfern Ltd., Engrs., Excelsior Life Bldg., Toronto, are preparing plans for sewerage and sewage disposal plant for Town.

Hamilton, Ont.
Tenders addressed to Mayor Coppley will be received by City Clerk, S. H. Kent, until Dec. 6th for sewers on King St. from Paradise Rd. to Sterling St. Plans with E. R. Gray, Engr.

City Council contemplate opening and widening Depew St. from Burlington St. to Hamilton Radial, and extension of Prospect St. from Balsam Ave. to Cannon St.

Lucknow, Ont.
Town Council plan construction of permanent pavement on Station Rd.

Ste Tite, Que.
Construction of macadam and concrete road between Ste Tite and Batiscan, Que., at Cost of $125,000 is contemplated by Prov. Gov't.

Three Rivers,. Que.
City Council plan extension to water supply system to cost $20,000 on Laviolette Plateau. Chs. Gelinas, Engr.

Plans are being prepared fir extension to Laviolette Ave. to cost $15,000 for City. Chs. Gelinas, Engr.

Plans are being prepared for extension to sewer to cost $6,000 on Blvd. St. Louis for City. Chs. Gelinas, Engr.

CONTRACTS AWARDED

Charlesbourg, Que.
Town Council awarded following road contracts: St. Pierre Rd., $32,500, Laganiere, Houde & Co., Neuville, Que.; St. Joseph Rd., $32,000, Universal Contractors Inc., 213 Drummond Bldg., Montreal.

Hamilton, Ont.
General contract for construction of storm and sanitary sewer costing $96,220 on Kenilworth Ave. for City is awarded to McLaughlin Bros., 574 Somerset St., Ottawa. E. R. Gray, Engr.

Montreal, Que.
Contract for paving on Christophe Colomb at cost of $27,000 for City is awarded to Bernard Brault, 2855 Rosemount Blvd.

Point Clairie, Que.
General contract for roadwork costing $55,000 for Town is awarded to Boyd & Rossi, 409 St. James St., Montreal. O. Beaubien, Engr., 71a St. James St., Montreal.

Russell Twp., Ont.
General contract for roadwork is awarded to J. Brule, Billings Bridge, Ottawa. Patterson & Byrne, Engrs., 72½ Sparks St., Ottawa.

Toronto, Ont.
General contract for earthwork, etc. for Prov. Highways Dep't. is awarded to McQuigge & Morse Ltd., Excelsior Life Bldg., Toronto.

Railroads, Bridges and Wharves

Brussells, Ont.
G. T. Rly. will rebuild station which was destroyed by a recent fire.

Grand Mere, Que.
City Council plan construction of highway bridge at cost of $200,000 over River St. Maurice from Grand Mere to St. Georges.

St. Omer, Que.
R. C. Desrochers, secy. Pub. Works Dep't., Dom. Gov't., Ottawa, will receive tenders until Dec. 12th for reconstruction of wharf. Plans with Dep't., and at offices of Dist. Engr., Post Office Bldg., Rimouski, Post Office Bldg., Quebec, Shaughnessy Bldg., Montreal, and Post Office, St. Omar. Accepted cheque for 10% of tender required.

Three Rivers, Que.
Dom. Gov't., Dep't. Pub. Works, contemplate construction of railroad terminals and deep waterways wharf to cost $100,000.

CONTRACTS AWARDED

Ile Perrot, Que.
Contract at $124,768 for superstructure for bridge from Ile Perrot to Dorion for Dom. and Prov. Gov'ts., is awarded to Dominion Bridge Co. Ltd., Dominion Station, Lachine. Contract at $135,140 for other work is placed with Dufresne Construction Co., Montreal. M. Denis, Engr. in charge, Room 505 Shaughnessy Bldg., Montreal.

York Mills, Ont.
Additional contracts for car barn, freight shed, office and station costing $50,000 for Ontario Hydro Electric Cmsn., are: Roofing, W. A. Moffatt, 14 Fallingbrook Rd., Toronto; heating, W. J. Hynes Ltd., 858 Dupont St., Toronto; painting, F. J. Roberts & Co., 106 Wells St., Toronto. Sullivan & Fried, general contractors, 81 Victoria St.

Public Buildings, Churches and Schools

Clifton East, Que.
Erection of school is contemplated by School Bd. E. Madore, secy., St. Malo.

Hamilton, Ont.
Warren & McDonnell, architects, Home Bank Bldg., are preparing plans for Sunday School to cost $50,000 for St. John's Presbyterian Church Congregation.

Erection of addition to General Hospital is contemplated by Hospital Bd. and City Council.

Nanaimo, B. C.
Canadian Western Fuel Co. will remodel bldg. for hall at cost of $6,000.

Pottersburg, Ont.
L. E. Carrothers, architect, London, is preparing plans for addition to school.

Quebec, Que.
Tanguay & Chenevert, architects, 20½ D'Aiguillon St., are preparing plans for addition to school for Catholic School Bd.

St. Ephrem, Que.
Erection of school is contemplated by School Bd. Alex. Quiron, secy.

St. Johns, Que.
L. J. T. Decary, architect, 22 Jacques Cartier St., will receive tenders from Jan. 1st to Jan. 15th, 1923, for erection of school to cost $80,000 for R. C. School Cmsn.

Staples, Ont.
Erection of church is contemplated by R. C. Congregation.

Three Rivers, Que.
R. C. School Cmsn. contemplate erection of 2 or 3 primary schools.

Welland, Ont.
N. A. Kearns, architect, Temple Bldg., has plans and will receive tenders until Dec. 4th for erection of library to cost $30,000. Plans also with MacLean Building Reports Ltd., 345 Adelaide W., Toronto.

York Twp., Ont.
Erection of school is contemplated by S. S. No. 35, York Twp. Andrew Duncan, secy., 12 Hillary Ave., Silverthorne.

CONTRACTS AWARDED

Kingston, Ont.
General contract for erection of laundry bldg. for Kingston General Hospital is awarded to McKelvey & Birch Ltd., 69 Brock St., Kingston. Stevens & Lee, architects, 62 Charles St. E., Toronto.

Painting contract for isolation hospital for City is awarded to F. G. Roberts & Co. Ltd., 106 Wells St., Toronto. Stevens & Lee, architects, 62 Charles St. E., Toronto.

Lethbridge, Alta.
Contract at $14,800 for erection of children's home for City is awarded to

ESTABLISHED 1886
Contract Record
and Engineering Review

A National Journal for the Construction Interests of Canada,
reaching Architects, Engineers, Contractors
Municipal Officials, etc.

Published Each Wednesday by
Hugh C. MacLean Publications
LIMITED
THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700
Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES
Canada, Great Britain and British Possessions $3.00. U. S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 **Toronto, December 6, 1922** **No. 49**

Remember the Conference!

Arrangements are now being completed by the executive of the Association of Canadian Building and Construction Industries for the annual construction conference which, on this occasion, will be held in Quebec City on February 6 to 9. The Quebec Builders' Association, which will act as host, is sparing no efforts to see that the delegates will be assured of a pleasant visit while the Dominion organization is now busy arranging the business program. From preliminary notices, it is judged that this fifth conference will quite come up to the standard set at previous gatherings and particularly the last one in Hamilton. It will be remembered by those present on the occasion that the Hamilton conference was especially inspiring and helpful; arrangements were exceptionally complete, and the spirit of co-operation that was prevalent was most beneficial to the whole construction industry. The Quebec meeting can be just as helpful, and even more so, if contractors throughout Canada will only lend their support by attending the conference and actively participating in its proceedings. It, therefore, behooves every contractor to do his very best to arrange his affairs so as to be free on February 6-9.

During the Winter most contractors are sufficiently slack to warrant their taking a few days off from their regular routine for the purpose of improving their ideas about their business. And that is just what these conferences are for—for disseminating information about the construction industry, for suggesting improvements, for exchanging opinions and for promoting co-operative measures for mutual advantage. Surely the beneficial effects of getting together once a year make it worth while for a contractor to attend these conventions. If he goes in the right spirit and with the right conception of the purpose of these meetings, he will undoubtedly derive benefit that will amply repay him for his time and effort.

The construction industry has long been backward in realizing its possibilities. For far too many years has it labored under a misconception regarding its rightful place in the upbuilding of the country. It is beginning to see the light, however, and contractors, individually as well as collectively, are realizing just how important an industry they belong to. The Quebec conference offers a further opportunity to improve this spirit. Keep it up by attending on February 6-9.

The St. Lawrence Ship Canal

There was a record meeting at the Ottawa branch of the Engineering Institute of Canada in the Chateau Laurier, when the Hon. J. A. O. Preus, Governor of the State of Minnesota, addressed the institute on the waterways situation, and the necessity for establishing a shipping outlet along the St. Lawrence River. The Hon. Mr. Preus made a number of interesting statements, one of which was that Minnesota needed the waterways very badly. It cost $22.77 to ship a ton of iron by rail from Duluth to Boston as against $5.55 to ship it by water. Another statement was to the effect that Buffalo was nearer to Liverpool than New York by 500 miles, which with an all water route would mean a saving of 5 cents a bushel in shipping charges on grain. He estimated the cost of building locks and dredging the channel of the St. Lawrence to accommodate ocean ships at $252,000,000 as compared with $400,000,000 spent on the Panama Canal. In this connection he made the further interesting statement that ten times the tonnage passes through the Soo Canal in open season, as goes through the Panama Canal in the whole year.

Expenditures on Terminal Works

With the cheque of $18,912.46 to the Canadian National Ry., passed by the executive council, total payments for terminal development work in British Columbia, have been brought up to $7,955,257, according to the figures passed by the B. C. cabinet in its order-in-council

Progress estimate for work in August amounts to $19,890.74, according to the government's figures. This work was confined to the Vancouver Canadian National terminals.

This brings the total Vancouver expenditure up to $4,015,666, which includes these items: For filling in False Creek $1,253,906.96, station $776,453.69, sea wall $229,619.35, freight sheds $169,889.56, train sheds $793,862, Main street improvements $62,184.

Terminal expenditures on the various terminals of the province are now brought up to these totals. New Westminster $1,842,106, Port Mann $1,187,715, Steveston $290,183, Patricia Bay $206,678, Victoria $412,848.

Honor!

GREAT BRITAIN is going to pay to the last farthing irrespective of whatever any other debtor nation does. England moved first in the matter of debt settlement, even before the people of the United States realized that nearly half their war debt represented loans to the Allies. England moved promptly because she meant to pay and to collect from her debtors if possible.

The majority of people in this country do not understand the word "honor" as respects debts and endorsement as the English understand it.

If an Englishman introduces a friend to his tailor, it is as an introduction to his club; the introducer is responsible for any debt.

The tendency of this country is to regard the tailor, the butcher or the grocer, or the merchandiser of any sort, as indebted to the introducer for a new customer.

If bank officials or bank directors were held responsible for the introduction of new customers, larger salaries would have to be paid and business might be very much restricted.

One of the largest banks in New York was not long ago surprised because the youngest director on the board promptly stepped up and paid the debt to the bank of a young merchant who had failed.

The bank director said "I introduced this young man to the bank for credit, believing in his ability to make a success of his business. For a time he made a very decided success and appeared to be above the ordinary in the intelligent handling of his business. Then came the big shrinkage in values which swept him over. I believe the bank extended this credit because of my introduction and though I don't believe, generally speaking that directors should be financially responsible for bank introductions, I felt I had a personal responsibility in this instance, which I could not overlook.

—*Barron's Weekly* (*N.Y.*)

No. 91

Canada's Engineers—D. L. McLean

The appointment of Douglas L. McLean, B. Sc., A. M. E. I. C., to the position of Deputy Minister of Public Works, province of Manitoba, has been a source of great satisfaction to his many friends throughout Canada and the United States. To the Engineering fraternity at large it marks a further recognition of their contention that executive positions of this type should be filled by technically trained men.

Mr. McLean brings to his new position a wide engineering experience and sound training gained under some of the most eminent engineers of this continent. His first engineering work was on the surveys of the National Transcontinental Railway in 1904. Following this he worked on maintenance for the C. P. R. and on a number of land surveys. In 1909 he graduated from McGill University in civil engineering, leading his class and winning the British Association medal and prize. The next year was spent in hydraulic and power development work in the office and field under J. B. McRae, consulting engineer, Ottawa. In 1910 he became assistant chief engineer of the International River Commission, St. John, Maine, U. S. A. Following this he took charge of the organization of the Manitoba hydrometric survey under J. B. Challies, superintendent of water power, Ottawa. For the next two years he was engaged as chief engineer of this work investigating the power possibilities of Manitoba. In addition to this he secured the data on the Lake of the Woods watershed for use of the International Joint Commission; investigated the South Saskatchewan water supply project near Elbow, Saskatchewan, and carried out a navigation survey of the Red River from Winnipeg to the boundary. In 1913 he joined the staff of the Greater Winnipeg Water District under W. G. Chace, chief engineer. He located the summit cut and intake division of that project; served as special assistant to the chief engineer on concrete studies, gravel production and cement inspection, etc., and later as division engineer, taking charge of some $2,500,000 worth of construction on the sections he had previously located. In 1919 he resigned to become engineer for the Manitoba Drainage Commission under J. G. Sullivan, as well as special lecturer in municipal engineering at Manitoba University, which work he has recently given up to take over the new duties of Deputy Minister.

Mr. Douglas L. McLean

Half a Million Dollars' Worth of Tenements in Three Rivers, P. Q.

During the last ten months, 154 tenements have been built in the city of three Rivers, P. Q. These represent an investment of $414,265. The unusual activity in this connection has been due to large industrial developments during the year. At the beginning of the year the St. Maurice Lumber Co., a branch of the International Paper Ltd., of New York, started operations on its new plant at the St. Maurice river outlet. This plant is located in the Ste. Ursule ward. The operation of these mills called for additional labor which had to find housing accommodation. Later in the year the St. Lawrence Pulp and Paper Co. Ltd., started the construction of its plant on the property bought from the Lamy's estate in the common.

According to the statement of the clerk in charge of building permits, Mr. Uld. Martel, tenement construction may be summarized as follows:—

January	2 tenements, valued at	$ 4,500
February	11 tenements, valued at	33,800
March	25 tenements, valued at	43,550
April	14 tenements, valued at	35,400
May	13 tenements, valued at	49,500
June	19 tenements, valued at	57,900
July	16 tenements, valued at	35,600
August	27 tenements, valued at	42,000
September	3 tenements, valued at	11,300
October	24 tenements, valued at	101,075

Practically all the dwellings were semi-detached with one to three tenements and constructed of wood framing, brick sheathing and finished inside with lime and sand.

The city clerk finds the building situation very satisfactory.

Among the public works which were carried on at Three Rivers during the last summer, there was the improvement to the Three Rivers harbor which consisted of demolishing a section of the wharf in front of the Boulevard Turcotte and rebuilding it in reinforced concrete. This work was performed by the Harbor Commissioners by day labor under the direction of and according to the plans of Mr. B. Grandment, district engineer, Department of Public Works, Canada

The reinforced concrete road on St. Christophe Island was completed in accordance with a contract entered between the city and Mr. Edmund Bourassa.

Construction Problems in the Remodelling of the Windsor Hotel, Montreal

Many Unforeseen Obstacles Had to be Overcome in the Placing of Footings and Erection of Steel for Extensive Alterations to Large Hotel—Length of Members Limited to 25 Feet

Early this summer the new management of the Windsor Hotel Company, Montreal, decided to make extensive alterations to their building. The principal part of the work consisted of the complete remodelling of the rotunda, the moving of the bar, etc., from its location under the Windsor Hall to the rear of the rotunda, and bringing the Windsor Hall down from the first floor level to the ground floor where the bar was at that time. It was also decided to provide for five stories of new bed-rooms over the Windsor Hall.

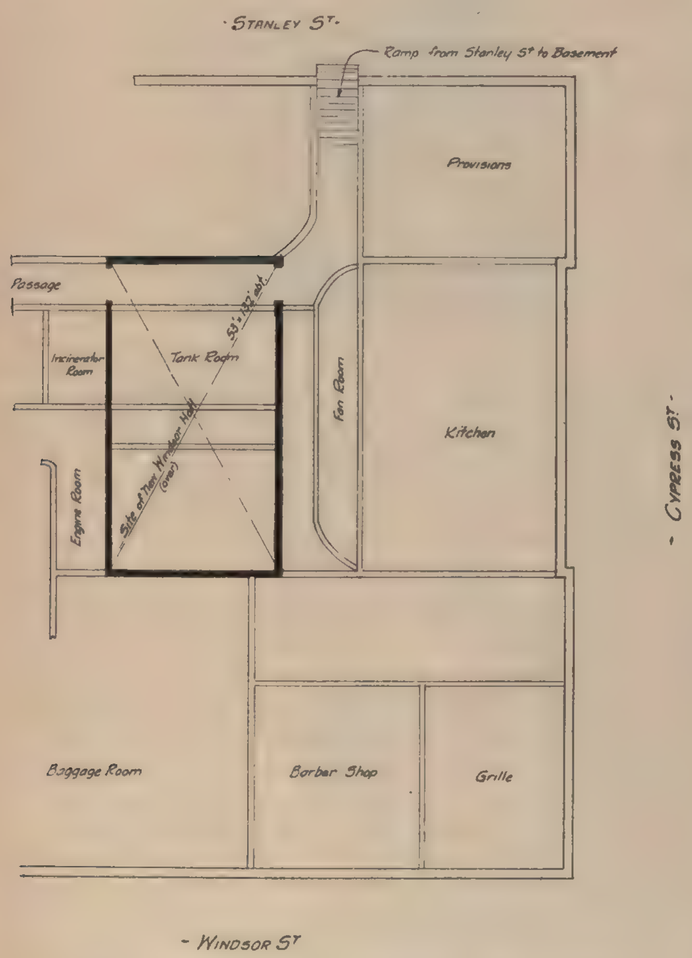


Fig. 1—Part basement plan of the Windsor Hotel, Montreal showing location of alterations

Contracts for alterations and for structural steel work were let about the middle of May, the first work to be done being the remodelling of the rotunda and the building of the new bar premises, so that the existing bar could be moved and work proceeded with on the main new structure of the Windsor Hotel. The original schedule called for the first part of the work to be completed by August 15th, so that on this date the Windsor Hall wing could be proceeded with, which portion was to be completed by November 1st. The dates set were both met, though many obstacles had to be overcome which were quite unforeseen when the contract was awarded.

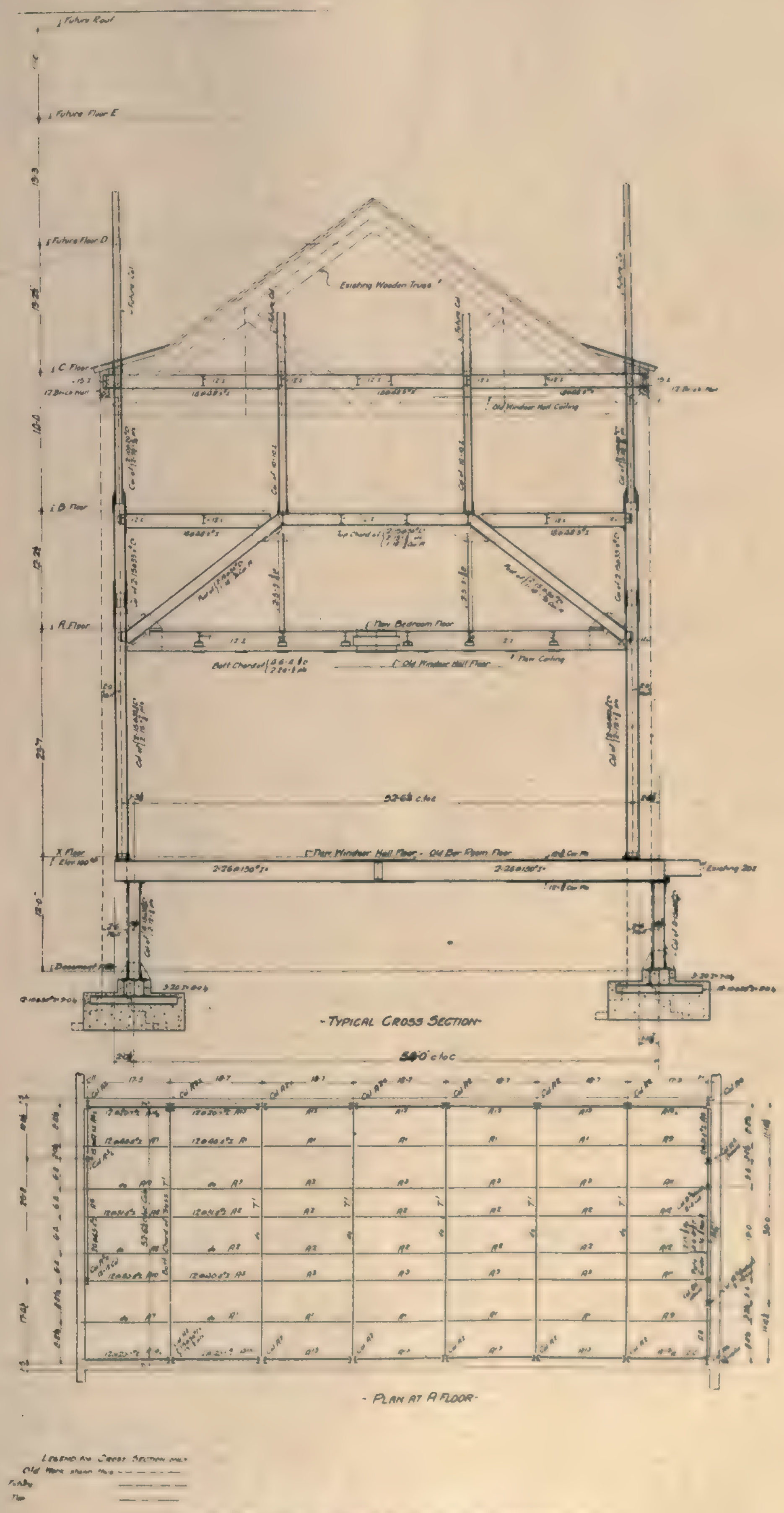
The sketch plan in Fig. 1 shows a part of the basement of the Windsor Hotel and the location of the Windsor Hall wing is indicated by heavy lines. The only access to the wing for materials and equipment was down a narrow ramp from Stanley Street, bending at right angles under a roofed-in passage. This passage was used throughout the conduct of the work, not only for bringing in and taking out material for new construction, but for all supplies for the hotel.

The digram in Fig. 2 shows the steel framework of the new Windsor Hotel wing. The placing of it developed some very interesting erection and construction problems. Owing to the narrow entrance it was necessary to unload all steel on Stanley Street, and to a large extent thereafter handle it by hand, it being impossible to use a derrick in any place with a boom over 25 feet long. The length of members was also limited by the bend in the passageway to 25 feet.

It was originally intended to run the wall columns straight down to new footings inside the existing building walls; but when the positions of the footings were located, it was found that in several instances it was advisable to change these locations, owing to the existence of steam pipes, transformers, boilers and other apparatus which had to be kept in operation. It was also deemed advisable, owing to the hard nature of the limestone in old basement wall, to keep all basement columns clear of this wall, rather than to cut chases in it; and the columns were therefore placed as shown on the sketch, a heavy girder of two 26" x 150 lb. beams being placed under the existing bar-room floor to support the superimposed structure. With the exception of the grillage and a few of the basement columns, no steel could be set until after the 15th of August, and the frame which had to be erected with old floors and roof in place, was completed by October 1st. The weight of steel handled was approximately 400 tons.

The work was carried out under the supervision of Mr. John S. Archibald, architect, by Peter Lyall & Sons Construction Company, Limited, general contractors, and the Phoenix Bridge & Iron Works, Ltd., contractors for the steelwork.

During the past fortnight, the following changes have been noticed in building supply prices on the Toronto market: Black sheets, 28 gauge, dropped from $5.10 to $5.00 per 100 lbs.; boiled linseed oil dropped from $1.20 per gal. in bbls. to $1.13 and raw linseed oil from $1.17 to $1.10 per gal. in bbls.; a 15 cent reduction is noticed in turpentine, from $2.35 to $2.20 per gal.; plain red oak flooring, ⅜ in. clear, dropped from $140 to $130 per M, and XXX B. C. cedar shingles from $6.50 to $6.35 per M.



- TYPICAL CROSS SECTION -

- PLAN AT A FLOOR -

Fig. 2—Details of the steel framework of alterations to the Windsor Hotel, Montreal

The Protection of Tile Pipe by Concrete

When Is It Necessary and at What Depth Should It be Used?—No Definite Rule Can be Laid Down Since the Angle of Repose of the Soil Through Which the Pipe Passes Has an Inportant Effect

By W. G. CAMERON, B.A.Sc., A.M.E.I.C.
Assistant Engineer, Sewer Section, Works Department, City of Toronto

In the September 15th issue of "The Surveyor," page 165, appears an article on the use of concrete around tile pipe, describing it as superfluous. The writer gives examples where tests have been made and also calls attention to places where pipes have been laid without concrete. He does not, however, make any mention of the class of ground in which the pipes were placed. He also gives actual figures; for example, he states that three inches of concrete is sufficient in most cases and that concrete should not as a rule be used on pipe when the pipe is laid at a depth of between three and twenty feet.

Experience in many cases has proved that the above statements may be true for ideal conditions, but conditions vary a great deal and are seldom ideal and then only for short distances. Accordingly, no rule can be made which will apply to all cases. The safe depth will depend to a great extent on the angle of repose of the soil through which the pipes is passing. For example, for dry clay this angle has been found to be 45 deg., wet clay, 17 deg., dry sand, 33 deg., wet sand, 3 deg., (Fig. 1). Any small accident like the bursting of a water main may alter the conditions. Where ground is sedimentary in character, as it frequently is, conditions will change very rapidly, very often several times in the length of one block. Then again, the angle will change with the lapse of time, also with the width of the trench. In cases which have been noted, clay will arch very rapidly, the time required depending on the consistency of the clay. It has been noticed that blue clay will even take the shape of the pipe, arching directly over it as in Fig. 2, and when in time the pipe breaks down, the clay will maintain its shape thus causing no interruption of service. In cases where the clay is loamy or where it has not been well packed, it has been observed that a certain amount will fall down on the pipe, but the ground will ultimately take its natural angle leaving a space between the fallen earth and where it has packed (Fig. 3). The natural angle of clay or any soil is usually normal where the trench is narrow, but as it widens, it is found that the angle tends to change, that is, to become more acute, this, of course, changing the depth of safety. Usually it would be wise where an angle is taken and a safe depth assumed, to double it for safety's sake and then add a little more. The writer of the article in "The Surveyor" is no doubt correct in the cases he has observed, but these cases are probably exceptional and his findings should not be taken as a general rule for all cases.

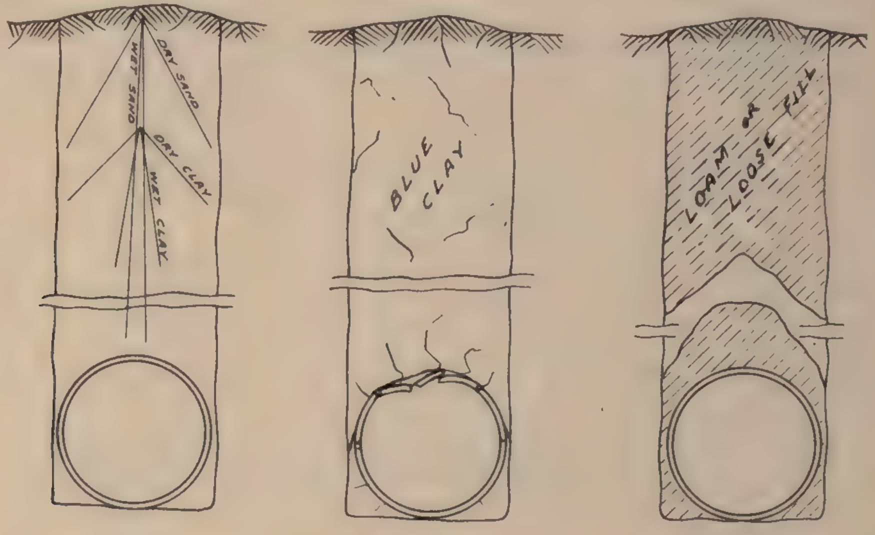


Fig. 1 Fig. 2 Fig. 3

Fig. 1—The angles of repose of various soils. Fig. 2—The arching of clay over a broken pipe. Fig. 3 The effect in loosely packed backfill

Queenston Stone For Queen's University

Canadian stone has been used for the construction of some of Canada's most beautiful buildings—which need not take second place to any on the continent either from the viewpoint of appearance or stability—and architects continue to show their appreciation of its merits. Among the most important contracts for stone which have recently been let is that on the new library building for Queen's University. The architects on this work are Shepard & Calvin, of Toronto, and the general contractors, Anglin-Norcross, Ltd., Montreal.

Kingston limestone is to be used for the main walls of the building, and Queenston limestone has been selected by the architects as the most suitable stone for the trimmings. The stone work on the building is being executed by the Ritchie Cut-Stone Co., of Hamilton.

The new Queen's library is the second very prominent building in the "Limestone City" on which Queenston limestone has been chosen for the trimmings, the other building being the Royal Military College erected by the Dominion Government immediately after the war.

These two instances lend color to the claim that Canadians need not go outside the borders of their own country to secure stone which combines fine appearance with high wearing qualities and adaptability to the various requirements of the building industry.

Snow Removal from Rural Highways

The Organization Required for Keeping Roads Open to Traffic in Winter Time—The Methods and Apparatus Used for Clearing Away Snow—Cost of Removal

The purpose of the following discussion is: First, to justify the need of snow removal from highways outside of municipalities; second, to discuss the methods employed up to the present time in carrying out this work, pointing out the weaknesses; and third, to outline in general a suitable organization to efficiently remove snow on interurban highways where traffic may expect service from the highway for three hundred and sixty-five days in the year.

Justification of Snow Removal

Highway engineers today are firmly convinced that the motor vehicle, whether passenger or commercial, has a very definite place in the transportation scheme of the country, that the magnitude of operations of these motor vehicles varies widely in different sections, but that there is hardly any place where motor transport is not a material factor in the delivery of passengers and freight.

These locations vary in importance on account of the character of business done or the class of commodity handled. In certain sections of the country where manufactured products are the main articles of commerce, the motor truck for the transportation of freight, or the passenger car for the transportation of passengers; in order to fill its proper sphere must, of necessity, be operated during the entire year, or with only such minor delays or discontinuances as may be easily taken care of by a short cessation of business.

If business were arranged with regard to climate, some of the problems of the highway engineers as regards snow removal would be materially simplified, but it is interesting to know that at least in certain sections of the country one-hundred per cent motor transportation is demanded, and in these sections, at certain times, snow falls in varying quantities, and the problem of the engineer in removal becomes a matter of very serious import.

Neglecting the argument that the removal of snow is of material benefit in the maintenance of the highway because the effect of removal on maintenance is slight, we must consider carefully the value of snow removal per se. No matter what we may say regarding highways or how much we may disregard traffic one of the fundamental principles of highway engineering must be that the road is built for the purpose of carrying traffic. Such a statement at first glance seems unnecessary and ridiculous, yet there are those of us who at times would fain build a road simply for the purpose of performing an excellent piece of construction and for no other purpose. Such men are those who entirely disregard the accommodation of traffic during construction or who make the inevitable remark in cases of snow storms: "Let the public stay home or use the trolleys."

Snow Removal is Often Necessary

Having established a system of transportation dependent partially upon the motor vehicle transportation, it would seem almost an axiom that every possible effort should be made to provide for the operation of this class of traffic at all times.

Previously, we have had little or no knowledge regarding the value of the road in actual units of cost. It has been easy heretofore, almost universally to provide other means of transportation when snow fell, but there are certain sections of the country, notably that from which the writer hails, where the use of motor vehicles cannot be discontinued without serious inconvenience to the public. May we not say, therefore, in closing this discussion that indications seem to prove that snow removal is necessary in those locations where motor vehicle transport has become a necessary factor in the commercial life of the community.

The added convenience to those who use the roads for passenger purposes for their own comfort or convenience, while not a commercial or economic factor, is certainly something to be taken into serious consideration. In other words, it may be justifiable, speaking in practical terms, to expend up to $300 per mile in order that the motor vehicle may get full use of the road instead of from fifty to sixty per cent of the use. This statement is further supported by the fact that in almost every instance of proper highway financing, we find the motor vehicle paying through license fees a sufficient amount of money to demand a one-hundred per cent service from the roads, or a reduction in license fee in proportion to the time during which the use of the roads may be discontinued.

Methods at Present in Vogue

We, all of us, are more or less familiar with the haphazard methods of snow removal employed, excepting in certain instances, and are familiar with the failures of these haphazard methods in particular cases. There are places here and there where snow removal has attained an important place in the work of the department having in charge the maintenance of highways, but these departments are still in the minority, and the methods employed generally are insufficient and expensive.

Based on the previous discussion of the need for snow removal and giving due weight to the importance and magnitude of the work to be done, particularly in the snow belt regions, we must admit that the problem of snow removal, if worthy of serious consideration, should be given such study as to provide the proper method applicable to the location in which the work should be done.

Ideal methods of snow removal are, of course, impossible to define excepting in a general way. Certain principles should be laid down. In order that the work may be successful, we must provide for speed. The attack must be sudden and continuous until the work is finished. This means expense, and a sacrifice of efficiency.

In general, the problem of snow removal varies between extremely wide limits. There are those sections where the fall is light in total, but where occasionally heavy snowfalls occur. In these sections, provision must be made for the complete removal of snow from interurban highways, for in these sections the use of sleighs is practically unknown.

From this class of locality to the other extreme is a long jump, the other extreme being the places where snow fall is heavy and continuous, and vehicular traffic, excepting over very much restricted distances, is unnecessary of consideration. In these localities, when winter comes, the use of the motor vehicle must be dispensed with unless its use becomes so important as to provide for heavy and continuous operations in snow removal.

Organization

As regards the organization for carrying on the work, this should be formed generally around the organization having in charge the maintenance of the highway system. In general, the men used in the Summer time for maintenance purposes may be subject to call, and the regular salaried personnel be used for supervising the work. In cases of extreme stress and emergency, advantages can be taken of local organizations or of contractors having special sources of labor or equipment. The work should be organized so that the necessary equipment is available at convenient points ready to go to work within a short distance of the point of storage. The work should be started immediately upon the commencement of snowfall of any magnitude. In many instances, the snow will stop falling very soon, and some of the work done will be wasted, but the advantages in the cases of extreme snowfalls of having the jump on the job will more than offset any loss due to work being done when unnecessary.

The organization should be reliable, well trained, with a knowledge of the job and with sufficient confidence in itself to carry on the work if the ordinary methods of communication, such as the telegraph or telephone fail. In other words, each man should know his job, be willing to take the responsibility of carrying on the work to completion and be subjected to little, if any blame if he makes serious mistakes, if these mistakes are honestly made.

Organization Ready at Any Time

The skeleton organization should be such that it covers the entire territory to be treated. There should be sufficient equipment available to do the job within a reasonable time and to do the job under maximum conditions rather than under average conditions. In other words, a great amount of equipment should be available and is absolutely necessary. This equipment should be in the very best of condition, housed in convenient and warm places, particularly in the case of motor trucks, so that it may take the character almost of a fire department subject to call in emergency and ready for the call without fail. This organization should be ready at any time, day or night.

It might also be said that the snow removal forces should be ready to take care of a snow storm in July if the same came. This statement is made merely to illustrate the necessity of being ready when the trouble comes.

No matter how large an organization may be attained, it will never be large enough to attack the problems of snow removal simultaneously at all points so as to clear the snow from all roads at the same time. In general, the problem resolves itself to those sections of highway which are more important and upon which the traffic may rightfully expect to pass within a reasonable time after the snowfall. In cases of continuous snowfall, it may be that the secondary routes will have to be neglected and traffic concentrated on the main routes.

In getting ready for the snow, we should take into consideration the co-operation with the weather Bureau; but it is well not to rely too fully upon these reports because in many instances we have had snow storms which were not foretold by the weather department, although, in general, the service is of great value, supplementing our own efforts, particularly in cases of extreme storms.

Methods

Apparatus for the removal of snow from interurban highways should possess the vital quality of speed of movement, Such apparatus should be strong rugged in construction, kept in good condition, and should be operated by men skilled in its use.

Inasmuch as the motor vehicle demands attention in traffic and is available in large numbers for work, particularly in the winter time, there is probably no more valuable agent for snow removal on highways than the motor vehicle with supplementary equipment.

Motor trucks have the added advantage of being available for other purposes in the softer seasons of the year and do not call for such a large investment in plant as would be necessary if machinery were purchased for snow removal alone.

The degree of snow removal depends upon the class of traffic to be accommodated, which has been suggested above. Where traffic is diverse in character, there will be a constant strife between horse-drawn vehicles and the motor interests as to whether the road shall be suitable for wheel traffic or for horses. In general, a traffic census will determine very quickly which is the more important of these two agencies to accommodate, and the degree of removal can be measured by the magnitude of use of either one or the other class of traffic.

The width of removal depends again upon the amount of traffic to be accommodated, but in general on heavily traveled routes, at least, a sufficient width for two lines of vehicles should be cleared, and if possible, snow pushed back during earlier snowfalls so that future snow may be more easily disposed of. In certain instances, snow paths may be provided on the side of the road to accommodate horse-drawn traffic which otherwise would be seriously discommoded.

Apparatus

Apparatus for snow removal has not been developed as fast as the motor vehicle itself. This statement, of course, is also true regarding the development of the highway systems. In general, the work of the highway engineer has, of necessity, lagged behind the needs of transportation, simply because the general public has not been alive to the value of this method of accommodating traffic Consequently, we are faced in the removal of snow with the same problem that we are in construction and maintenance of highways. We have not developed our methods sufficiently to provide for snow removal, nor have we designed and constructed apparatus of a character to properly do the job.

In general, as outlined previously, the methods employed have been haphazard and advantage has been taken of the equipment available such as horses, oxen and plows, hauled or pushed by trucks, but the time must come when special mechanical devices, capable of attaching to motor trucks, or even operated under their own power, must be designed for the purpose of snow removal. The use of animals for snow removal purposes should receive only a remark in passing that in certain sections of the country, the use of draft animals will always be of value in this work, but on interurban highways where the roads must be opened quickly for vehicular traffic, the use of animals is obsolete.

Modern snow removal naturally means the use of mechanical apparatus operated by gasoline motors; in other words, the truck with appliances attached, before or behind, or with a high class of mechanism designed particularly for the purpose of removal of snow. A great deal of advice has been made in the design and construction of this class of apparatus. At the present time, probably the most successful mechanical device and the most universally used is the Scraper blade attached in front of a motor truck and set at an angle, used for the purpose of pushing the snow from one side to the other. Such a truck can be operated with continuous shifts of men if kept in good mechanical condition, and do an enormous amount of work, working 24 hours a day, even up to seven days a week.

Spare parts and repairs facilities must be available, especially where the truck is used thus continuously. The number of these trucks to be used will, of course, depend upon the degree of snowfall and the amount of work to be done.

In general, the truck will probably clean a reasonable snowfall on twelve miles of road in twenty-four hours, but in certain instances, the truck will be stalled so that it will only do a very small portion of this work in the case of an extremely heavy or wet snowfall.

In our section of the country, the weight of the snow varies between very wide limits. The light snow weighing from twelve to fourteen pounds per cubic foot will often be followed immediately by a fall of snow from twenty-two to twenty-four pounds per cubic foot.

Plows Must Handle Light and Heavy Snow

The apparatus for removal must be designed to handle the heavy snow, and yet be operated carefully in the light snow to obviate breakages. The advantage of using the motor truck with the plow in front is, of course, that the truck may be used for other purposes in the summer time. The disadvantage is that the use of the truck for snow removal has a serious effect on the efficiency and life of the truck, itself, especially, when used for other purposes at other times. In other words, it is the opinion of the speaker that if the truck is used for a combination of snow removal and ordinary maintenance work, it should be charged up with 33% depreciation each year. In other words, the truck will be used up at the end of three years a description of the truck with scraper in front is unnecessary, although an illustration of this will be shown later on in the discussion.

The use of this equipment is restricted, of course, to roads which have a reasonably hard surface and during snowfalls which are not seriously drifted. The drifting, of course, may be prevented by promptness in execution during the snowfalls or the proper installation of snow fences at danger points. Drifts may be removed or broken out by the use of tractors with plows in front or behind. In general, the placing of the plow before the truck provides better footing for the wheels, or traction device than if the scraper or plow were pulled.

As we get into the niceties of snow removal, we will, however, find a use for other apparatus, some of it of the ordinary type, and much of it especially designed.

In order to start a discussion on this matter, it is the firm opinion of the writer that no method of snow melting or snow compression will ever be successfully operated due to the tremendous amount of heat or power necessary to melt the snow and to the probable defects due to freezing or chocking of the apparatus itself, so that this discussion will neglect absolutely devices of this character and will confine itself principally to the mechanical means of removing snow in practically the same manner that earth is moved, although the material is of less weight per unit.

Earth Removal Devices Inadequate

Viewed as an earth removal proposition, the apparatus designed for the removal of earth would be applicable to snow, excepting that the quantities of snow to be moved would be extremely large, and the allowable cost per unit must be very low, so that the devices for snow removal must be designed to handle large quantities at a time at speed and distribute the material in waste places without particular regard to appearance. Consequently, the ordinary earth removal devices are inadequate because they are designed to carry heavy material, but modifications of these devices can be made to be accommodated to the handling of snow.

Modifications of the conveyor, loader, the steam shovel and the steam excavator can be made so that these can be applied to snow removal. Several types of equipment have been manufactured here and there which indicate a study on the part of the manufacturers realizing the magnitude of the snow removal problems.

We are, all of us, familiar with the centrifugal plow which has been used and advertised in Canada. The difficulty with this machine is that it is only hauled by horses and is restricted to the speed at which horses can travel. It disposes of the snow by throwing it up in the air and deflecting it on the sides of the road; and in this respect it is useful, of course, on interurban highways. The width of path cut is narrow, and the radius of operation limited. Possibly some modification of this machine using a motor vehicle instead of horses for the tractive agent may be devised.

Other snow removal machinery of special character is as follows:

The snow tank which collects large quantities of snow in a receptacle and loads it into trucks or carts. Such a machine is, of course, of great value in the city and may be applied to the removal of snow in country districts.

Rotary Broom Devices

Then, we have a rotary broom similar to those operated by the trolley companies, which is operated by a special motor or broom being set at an angle and being revolved in the opposite direction to the wheels of the truck so as to throw snow forward and to the side. The expense of installing these machines is, so far, the only drawback to their operation which can be justified in certain instances where the desire or demand for snow removal is more insistant.

There are other devices which are on the market at the present time and which are subject to examination. The writer has attempted to get information together regarding all the apparatus manufactured for snow removal purposes, and has seen quite a few advertisements and catalogs, none of which, however, seem to be in a condition to admit of very much discussion.

There is, of course, the snow compressing machinery. There is also a snow removal machine which consists of a continuous belt with cutting baffles operated at a high speed by an independent motor. There are rotary plows and deflective plows of all kinds, but none of these have come to the point where they can be successfully used. These are simply mentioned for purposes of discussion.

Prevention of Snow Drifts

All our statements previously have been made looking toward the removal of snow. We must not close a discussion of this kind without making mention of the absolutely important need of taking measures for the prevention of snow drifts by the erection of snow fences or the removal of obstructions such as weeds, hedges, board fences or anything of temporary character which will tend to cause snow drifts within the traversed portion of the highway.

Like the problem of snow removal, the installation of snow fences requires forethought. It should not be left until the snow falls. Snow fences should be up before there is any possibility of snow drifts, and should remain in place by arrangement with abutting property owners until the possibility of snow has ceased. Snow fences can easily and cheaply be designed. There is no necessity of going into detail regarding the type of snow fence to be constructed. The location of the fence, however, is a vitally important factor.

In conclusion, let it be said that snow removal is a very real problem; that it will be a very real problem and increase in magnitude as long as we have motor vehicles; that the amount of money to be expended on snow removal will only be limited by the value of service to traffic; that the cost of snow removal will vary from $50 to $250 per mile, and in cases of extreme snowfall, the cost may run even higher. Much of the work is thrown away, discouraging, and must be done over again. The permanent results are practically nothing. The work is done for the purpose of providing facilities for the motor vehicle, and should be included in the cost of the motor vehicle itself.

From an experience lasting over a considerable number of years in the fighting of snow, the writer has reached the point where he is extremely disturbed when the snow begins to fall, because it costs money to remove and the money might just as well be thrown away for all the effects the greater share of the expenditure has on the condition of the roads in the future.

The above paper was presented by Charles J. Bennett, State Highway Commissioner of Connecticut, before the eight annual conference on highway engineering at the University of Michigan.

The Controversy Regarding Hydrated Lime

The Chief Engineer of the National Lime Association Supports Statements to Which Objection Was Taken

Washington, D. C.,
November 22, 1922.

Editor, Contract Record,

I note in your issue of November 15th, 1922, a letter from Duff A. Abrams commenting upon the talk I gave before the City Paving Conference.

I am at a loss to understand the significance of the reproduced letter from Mr. Bates in view of the following quotations from Technologic Paper No. 3 of the United States Bureau of Standards by Wig and Bates. On page 59 of the paper is to be found:

"Compound 27b.—This is the most efficient medium employed and resulted in an almost impermeable mortar at the two weeks' test. Its value is probably due to its void-filling properties and the same results could be expected from any other finely ground inert material such as sand, clay, etc."—Compound 27b was hydrated lime.

No fault is to be found with the statement that finely ground sand, clay, etc., will be as effective as hydrated lime. When the cost of producing ground sand, clay, etc., of the same degree of fineness as hydrated lime is considered, the advantage of using hydrated lime is apparent.

On page 62 in discussing the effect of integral waterproofing materials in 1-6 mortar mixes we find: "The efficiency of 2 per cent of inert hydrated dolomitic lime filler is apparently as great as that of any of the water-repelling compounds in this mortar. Compound 27b was the most effective waterproofing medium in this mortar."

On page 64: "The value, for dampproofing purposes, of the addition of compounds to a 1-4 mortar mixture is evident from the result recorded in the table. It will be observed that all the mortars containing water-repelling compounds were dampproof; also the mortar containing 10 per cent of inert hydrated lime filler, but the mortar containing only 2 per cent of the hydrated lime failed."

From these quotations it is evident that I was fully justified when I said: "The statement to the effect that it is the most efficient medium has been made by the U. S. Bureau of Standards as the result of an exhaustive series of tests in which all of the available media were experimented with."

Carefully selected and partial quotations can be made to convey almost any desired impression when considered aside from the complete test. The following quotations are from the same summary as are the ones presented by Mr. Abrams.

"The mortar used in these tests was, perhaps, too coarse and too absorptive for a fair test."

"Well graded sands containing considerable graded fine material are preferable for making impermeable concrete but if such is not to be had, fine material in the form of hydrated lime, finely ground clay or an additional quantity of cement will be found of value."

No one familiar with concrete will deny that it is perfectly possible to make it impervious when nothing but cement and aggregates are used. As so well expressed in the quotation given by Mr. Abrams, though, we know that "...... in order to obtain such impermeable mortar or concrete considerable care should be exercised in selecting good materials as aggregates and proportioning them in such a manner as to obtain a dense mixture ...." The engineer or builder who makes his concrete in the field for practical use, instead of in the laboratory for theoretical discussion, appreciates the difficulty, and often the impossibility, of meeting these apparently simple requirements.

It would appear that Mr. Abrams is his own prestidigitator in the "act of legerdemain, which might be entitled 'Water, water, who has the water.'" On page 58 of Bulletin No. 8 of the Lewis Institute we find in connection with the discussion of a series of tests in which the water was kept constant: "The quantity of water for each specimen was fixed at an amount that would give a plastic concrete for the highest percentage of admixture, consequently the concrete became progressively drier and drier as hydrated lime or cement was added." And on page 69 we find: "The increase in strength with the addition of hydrated lime in group 3 is to be expected; the absorbtion of water by the lime thus producing a drier concrete as the quantity of lime was increased."

The tables as presented on page 65 are misleading and do not show what is claimed. Comparisons are made between concretes containing hydrated lime and those with incremental additions of cement, in other words, with concretes becoming **constantly richer.**

For instance in the reports for group 3, "mixing water constant," when 33% of cement is added to a 1-5 mix it becomes a 1-3.76 mix, when added to a 1-4 mix it becomes a 1-3 mix. In the cases of groups 3 and 4, mix 1-4, admixture 33%, he compares the flow and strength of a concrete of 1-4 mix with 33% of about relative consistency 105, with the flow and strength of a concrete of mix 1-3 of relative consistency about 105.

According to his own acknowledgment all of the concretes in his group 3 were plastic, the strength results given for his group 3, mix 1-4 with mixing water constant (page 65, bulletin No. 8) show an average improvement in strength of 10.9 pounds per cent of hydrated lime added and this for all percentages of hydrated lime added.

In his letter he admits "that if there is an excess of mixing water in concrete it will leave corresponding voids which will in turn lower the load-carrying capacity of the concrete and greatly reduce its resistance to weather and other destructive agencies." On pages 58 and 69 of his bulletin No. 8 he admits that hydrated lime absorbs water. In his Table XXIX (page 65) he shows that for constant water in plastic, workable mixes the addition of hydrated lime increases the compressive strength. In my paper I did not claim an increase in strength, Mr. Abrams has said exactly what I said but in separate places and in other words. We appear to have exposed the "act of legerdemain" and to have discovered "Where the water is at."

The data alluded to from which the conclusions as to the "rate of evaporation" and "absorbtion of water" in concretes containing hydrated lime were drawn, are hardly such as to make much of an impression on the engineer. Mr. Abrams refers to Figure 13, page 49, Bulletin No. 8 of the Lewis Institute. Figure 13 consists of a series of small graphs that are plotted so as to show the **average effect** "of all percentages of hydrated lime," (from 5% to 33%) on each of the mixes from 1-4½ to 1-2½ (about 1-2-3½ as the leanest mix) and as the average effect of each of the admixture percentages on the average of all of the above indicated concrete mixtures. Extended discussion of these data is hardly necessary.

Much test data resulting from observations on practical concretes and observed under practical conditions could be cited in substantiation of the statement that both the permeability and absorbtion of concrete are reduced by judicious and reasonable admixtures of hydrated lime.

There appears to be no reason to change the statement to the effect that "numerous tests have demonstrated that the compressive strength of concrete is little affected by the presence of hydrated lime, the majority show a slight increase, **when the tests have been conducted under conditions approximating field conditions.**"

A complete discussion of the erroneous assumptions and empirical methods used in the tests from which Mr. Abrams drew the conclusions he quotes, will appear in the forthcoming volume of the "Proceedings of the American Society of Testing Materials" so that no further comments will be made here.

It is unfortunate that Mr. Abrams was not more familiar with the Bates road test. According to our reports, hydrated lime was used in Section 61A. The concrete in this section was of a basic 1-2-3½ mix with 7½ per cent of hydrated lime. The section was 100 feet long and but 4 inches thick. This section was selected to make studies as to the effects of hydrated lime in concrete mixed for different times. The easterly 33-1/3 feet was mixed for only 30 seconds, the next 33-1/3 feet was mixed for 45 seconds and the westerly 33-1/3 feet for one minute. The easterly section (mixed 30 seconds) failed under the second load increment, the middle section (mixed 45 seconds) failed under the third load increment but the westerly section (mixed one minute) stood up until the fifth increment or as well if not better than any four inch section of the whole road.

Very truly yours,
Tyrrell B. Shertzer,
Chief Engineer, National Lime Association.

The Standard Underground Cable Co., of Canada, Ltd., are distributing a booklet describing their rubber insulated wire. The booklet is nicely illustrated and contains much interesting information.

Experiences with Leadite for Pipe Joints

A Discussion of the Value of Lead Substitutes—Water Works Officials State Their Opinions of the Effectiveness of Joints Made with Leadite

At the last annual convention of the American Water Works Association, a paper on the use of lead substitutes for pipe joints provoked considerable discussion, which is of sufficient interest to be worth reprinting. The following, therefore, are some experiences with the use of leadite and other substitutes:

W. Luscombe:[1] I have never tried anything but pig lead. Some representatives, speaking to me of leadite, stated that in Philadelphia it is now being extensively used on a considerable mileage of large mains under streets where it is extremely difficult to reach the joints. Philadelphia must have found it very satisfactory, or else they would not have used it. However, I have never used anything but pig lead, which I have found satisfactory.

W. C. Hawley:[2] I have some 75 miles of pipe laid with leadite joints. It has been entirely satisfactory and is much less expensive. I figured that we have saved about 60 per cent in the cost of the joints during the recent war period. The other day my foreman brought in a piece of joint which was taken out of a ten inch pipe where the line had settled into a coal mine, and in breaking out the bell he had the joint in pretty nearly one piece. There was no evidence whatever of any deterioration in the metal. It was as perfect as any jointing material could be. We are using it under all sorts of conditions, in trenches four and four and a half feet deep, which stand the vibration due to the use of heavy automobile trucks, and we are using it under pressure up to 210 pounds and in sizes from four to thirty-six inches.

E. T. Cranch:[3] I would like to ask about the experience necessary in handling leadite. I have never used it myself. I have been approached by representatives to undertake it and have discussed it with several. The principal objection I could find is that I am told you are likely to overheat it and it is no good if it is overheated. I wonder what the experience has been in that line?

W. C. Hawley:[2] Leadite is different from lead and has to be handled differently, but, used with any intelligence, there is no reason why good results cannot be had. As far as overheating is concerned, that is the thing to do. It comes in the form of black powder and as it melts it should be stirred. It will froth and foam, and then as it gets a little too hot, it begins to thicken like a black oatmeal mush and that is the time to take it away from the fire or take the fire away from it, and to continue to stir it. It will thin down until it is like a thin black oil, and then it is ready to pour. If poured from the proper height, eight or ten inches, there is no difficulty at all. Anybody can use it, but it is just enough different from lead to require a little different treatment. We break in an Italian boy to pour the joints. It does not require expert labor. We get rid of all the trouble with caulkers and that sort of thing, and we find a saving, as I said, of 60 per cent in the cost of the joints.

J. E. Gibson:[4] I want to reinforce, if I can, what Mr. Hawley has said. I have used leadite now for about four years, and have found it entirely satisfactory. I did have difficulty when I started to use it. I got it afire and smoked everybody out of the community in that section, but now we have gotten on to it and find it very satisfactory. During the last two years we have rebuilt our filter plant, and, as we all know, the pipe gallery is forgotten until we begin to erect the pipes, and then we find we have four feet of space for six feet of material. We used leadite there and saved a good many dollars, because without leadite, if it had been necessary to caulk lead, we would have had to put in flanged pipes. We could pour the leadite in six inches of space and no caulking was needed. We did have leaks under those conditions in one or two cases. We had a stream pouring out of a twenty-inch connection that would fill a gallon pail in a few minutes, but after eight or ten days the leak stopped and since then we have painted the pipes without any difficulty whatever.

We cannot use it in water that will not rust. We have in Charleston an artesian supply. It carries about 2,000 grains per gallon of soda, a good mineral water for drinking and bathing, but it is not useful for anything else. Laundry work done with it is most splendid. It will wash clothing and it will come out beautifully white. That water will not rust iron. I took out in 1921 some pipe placed in 1897. The threads were just as sharp as the day they were turned out of the die, the tool marks were still there but, after twenty-four hours' exposure in the salt air of Charleston, they were rusted. But there was a pipe absolutely clean that had been submerged for twenty some odd years. We have got the artesian pipe still in the ground, and people still want that for bathing. We have repaired a few joints with leadite on that, but it will not hold, so if you have a water that will not rust ordinary iron, I would not suggest that you experiment with leadite. It seems to have that quality of rusting tight like our old style rust joints that we made years ago.

W. F. Wilcox:[5] I do not know anything about leadite, but I was going to give an experience with pipe joints in our district. We laid two miles of 24-inch pipe carrying a million cubic feet of gas an hour under 10 pounds pressure. In that two miles of line we finally drove up 3,500 leaks. We had to put in another line to carry two million cubic feet of gas an hour under 10 pounds pressure, and we put in a joint there by using one inch of untarred jute yarn, driving that up hard, and then drove in one inch of lead wool, then another inch of jute yarn and cast on top of that an inch and a half of poured lead joint and drove it up. In three miles, the 36-inch pipe carrying two million cubic feet of gas under 10 pounds pressure, the joints we have had to redrive have been so negligible that we have not kept any record of them. On the first line, with the same joints, we spent more in redriving leaks than it cost us to lay the original line. That looks like a complicated joint, but it did make a big difference.

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[1] Vice-president, Gary Heat, Light and Water Company, Gary, Indiana.

[2] Chief Engineer and general superintendent, Pennsylvania Water Company, Wilkinsburg, Pa.

[3] Superintendent, water department, Petersburg, Va.

[4] Superintendent, water department, Charleston, S.C.

[5] Superintendent, Central Water Works, Ensley, Ala.

W. C. Hawley:[5] Perhaps the convention will be interested in a test we made the other day of a line of 6 inch pipe 7,800 feet long we laid with leadite early last fall, but which we did not test until just before cold weather. The test was not satisfactory. The joints had all been tested in the trench, but there was evidence of too much leakage. Probably they did not get the curb tap turned right, but we retested that line about three weeks ago, and the first seven minutes the meter registered two-hundredths of a cubic foot and in the next ten minutes, six-hundredths of a cubic foot. That rate of registration is probably too small to indicate satisfactory results, that is, I mean the meter can hardly be expected to register accurately at such a low rate, but at any rate the leakage is very small in about 7,800 feet of 6-inch pipe.

H. F. Cox:[6] I should like to add our testimony. In Scranton we have the same trouble. Our Wilkesbarre people have been using leadite three or four years. We made a visit down there to see how it was done, and it is largely a matter of skill in heating. They use common labor and we have been doing so since. Our trouble was under tracks, and we have put leadite in and have had no trouble. We have not used it under paving yet. We also had mains joined over the bridge under tracks and also ran the leadite where we could watch them. As Mr. Gibson said, we had small leaks which continued for a period of four or five weeks, but finally it all took up, so our experience with it has been very successful so far.

G. G. Dixon:[7] Like some other places, Akron had a little unfortunate experience a number of years ago with leadite, and in recent years we have never used it in practical quantities, but last year we put in about 2,000 feet of 10-inch pipe in about as bad a piece of trench imaginable. It is very difficult work. It was placed in February or March. Leadite was used and no service connections were made into the main for some time after it was completed, so as to give an opportunity for testing accurately with a pressure meter. This was done, and something over 100 pounds pressure was found. The meter was read daily for a period of two weeks, during which time the leakage dropped from about 500 gallons per day per mile of pipe to about 250. Our standard of leakage in those times was about 200. The meter was then read again about a week and a half later, and the leakage had by that time dropped a little below our standard of 200. It took something between three and four weeks for the leakage in that case to drop down to our standard.

J. A. Jensen:[8] You may be interested in our experience in Minneapolis. We had a section cut off temporarily and there was laid on the top of the ground a 6-inch main. Some people interested in substitutes for lead asked for an opportunity to make a demonstration and we thought we would give them a chance on this line. They did not get on the job right away, so we started to make lead joints and they finally came out and finished the job with substitute. This line was in service for 90 days, and they made the joints themselves according to the usual practice with a high gait. At the end of 90 days, when we were ready to take the pipe out, we made an inspection, and I might say that, out of the 45 or 50 joints that were made, there were only about 2 that you could call passable. There was a great deal of leakage, but all of the lead joints were dry. Where we laid the pipe 8 feet below the grade of the street, we might hesitate about taking any other material as a substitute for lead. The joint is the weakest point in the pipe line, and, therefore, we would hesitate naturally about using something that might be inferior. We figured out that, of the total cost of a line of 12-inch pipe, the cost was about 2 per cent more by using lead, and we felt that that was mighty cheap insurance.

S. H. Taylor:[9] Perhaps I should give you the benefit of New Bedford's experience in lead pipe. I was very skeptical and thought I was going to avoid using it by proving it to be no good. About 15 years ago there were a few joints made experimentally in New Bedford and covered up. As is usual with leadite, the first week or so produced a little water, but it tightened right up and has given no trouble since. About 3 years ago we were about to do considerable work, about a mile and a half of 36-inch, and are now doing nearly 4 miles at Wauhegon. Of course the leadite men were around and we agreed to make a test. We put six pipes together, 3 with leadite and 3 with another substance, and put them up to 200 pounds pressure with no disastrous result. Then we started to pick up the two ends with a derrick so that we got the pipe practically suspended by the ends. I was much surprised at the elasticity of the material, for only one joint broke, which was not leadite. Then we laid the end on the ground and caulked up that break with lead and the six lengths of pipe lay in the yard for a month, absolutely tight. Since then, for the past 3 years, we have used leadite almost exclusively with very good results. I recall only one or two cases in many miles of pipe where it was used that we had to make a joint afterwards. We have laid in that time probably 7 or 8 miles of ordinary size pipe 6 to 12 inches, and over a mile of 36-inch and over a mile of 48-inch pipe. We are now laying more 48-inch and we are so well satisfied with the leadite that we are sticking right to it. We show a saving in our 48-inch joints of about 75 per cent, without taking any account of the difference in the bell hold, that is, simply on material and labor. It requires about 3 men to make a leadite joint in 10 minutes, and the same 3 men would take an hour and forty minutes to make a lead joint. That, in addition to the cost of the material, makes a difference of about 75 per cent and saving in bell holds is additional to that.

C. Nelson, contractor, Coleman, Alta., has recently been awarded a contract for a picture theatre at Coleman, 25 by 100 ft. It will be of frame construction on concrete foundations. The estimated cost is $6,000. A. E. Knowles, cement contractor, has received the sub-contract for the foundations. The owner is C. Baron.

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[6] Chief Engineer, Scranton Gas and Water Company, Scranton, Pa.
[7] Chief Engineer, Bureau Water Works Improvement, Akron, Ohio.
[8] Supervisor, water works department, Minneapolis, Minn.
[9] Assistant Superintendent, Water Works, New Bedford, Mass.

Deterioration of Materials Employed in Harbor Works

An Abstract of the Second Report of a Committee of the Institution of Civil Engineers as Published in "Engineering"

Since 1916, an important committee appointed by the Institution of Civil Engineers has been engaged in investigating the causes of deterioration of structures, partly or wholly immersed, in sea water, and in devising measures that would ensure longer life to materials subjected to such conditions. The war necessarily occasioned some delay in the active prosecution of this work, and the first report was not issued till four years later. In that report, the problem was very fully stated, the necessity for inquiry was clearly demonstrated, the available mechanism for dealing with it was explained, and the lines of investigation to be followed distinctly detailed. The committee of the Institution has now published a second (interim) report, which besides showing the progress that has been made, contains a number of abstracts from the proceedings of various committees and associations, English and foreign, indicating the interest the subject has created throughout the world. Various officials have also made reports on matters of particular interest.

Protection of Timbers

The more efficient protection of timber was a subject in which the committee were closely concerned, and the provision of appropriate forms of preservative engaged their attention from the first. Creosote offered the most promising means of effecting an improvement, and they now report the progress made by experiments, to determine the suitability of creosote and the possibility of rendering the creosote more effective by the addition of poisonous substances. With regard to the first part of the inquiry, the committee report that specimens of timber have been purposely exposed at Accra, Auckland, Brisbane, Colombo, Wellington and Leith, and that from some of these stations have been received specimens of native timber, that had been submitted to tests with the view of determining the maximum load, the modulus of rupture, the modulus of elasticity and total deflection previous to fracture.

Of course it is as yet much too soon to draw conclusions from the systematized experiments proposed by the committee, but at Auckland observations made in timbers exposed to the attack of teredo and other pests have been continued. Some specimens of timber, 42 in. by 3 in. by 1½ in., in an unprotected condition, and others that had been protected by crude creosote and patent protectors, had been exposed in sea water up to May, 1920, but it is not quite clear how long they had been in the water when examined. All, however, were found to have been attacked by the teredo: Kahikatea, severely; Rimu and Kauri, less so, but Oregon pine had disappeared, having been completely destroyed. Mr. Marchbanks, chief engineer of the Wellington Harbor Board, in sending specimens with description of tests states, "that the timber suitable for harbor work is getting scarce and difficult to obtain in New Zealand and that the Colony is getting more and more dependent on Australia for supplies. Under these circumstances, it is submitted that the question of the suitability of New Zealand timber for other than limited local requirements is no longer of great importance."

Studies in United States

Other reports indicate active co-operation and eagerness to participate in the inquiry, and outside our own Colonies very material assistance is likely to come from the United States. The American Wood Preservers' Association has taken up the subject with vigor, moved to this end by the very serious loss due to the action of marine borers on the harbors of the Pacific Coast. This association has issued a report which shows that a very thorough and systematic investigation will be pursued throughout the whole length of the coast line of the United States. It appears that in past years, since 1870, the attacks in San Francisco Bay have been sporadic and varying in virulence, but in the earlier period little attention was paid to the pest, as it was believed that the quantity of fresh water discharged into the bay from the combined flow of the Sacramento and San Joaquin rivers would reduce the salinity of the water to such an extent that it would prove an unfavorable habitat for Teredo and Limnoria. This expectation apparently was not well founded, and with time the depredators have increased. It may be suggested that the enormous quantity of water drawn from the upper reaches and tributaries of these rivers for the purposes of irrigation has diminished the supply of fresh water, and has allowed the salinity at the outfall to increase to such an extent that the breeding of the teredo has been encouraged. Moreover, in recent years the rainfall has been below the normal, and it is in those years that the ravages have been the greatest. In 1917, damage to timber piling became evident, and two years later, waterfront structures in the bay erected on piles, began to fall, and in some cases whole docks were affected. Loss and insecurity became so great that the Wood Preserving Association appointed a committee to study the problem, but this committee did not begin active work till July, 1920. Previous to this date, the United States Forest Service and other agencies had made local investigations concerning the activities of Marine borers and the methods for their due control. These scattered associations have now concentrated their efforts in a systematic programme, which has for its object the investigation of the entire problem, including the hydrographic, the biological and the engineering phases. The biological work carried out under the superintendence of Dr. C. A. Kofoid shows that invasions of borers are induced by the shipping traffic, and that preventive measures are an absolute necessity. The port of San Francisco has become the resort of the most widely known and most destructive representatives of the groups to which they belong. To these importations, however, California contributes, on its own account, a pest of special virulence. The Xylotrya is, however, no mean second in the competition, and though it adopts unusual habits of boring they can prove very effectual. Some of the piles in the dolphin of the Alameda Mole, driven in February, 1919, were so weakened at the mud line by the tunnelling of Xylotrya, that they had to be removed in November, 1920. Teredo navalis can accomplish 4 in. penetration in as many months, and is a foe to be respected. Among the crustacean borers is the Limnoria Lignorum, a species which acquired considerable notoriety in the last report, and whose ravages are very destructive since they often complete the work of the teredo.

Protection of Piling

The recommendations submitted to the committee for coping with the destructive work of these organisms seem hardly adequate, but time will be required to determine their efficiency. It is proposed to restrict the uncontrolled use of untreated or unprotected timbers in marine structures, to remove by state or federal sanction all old, unused, infected marine structures, and to prevent harbors being used as a dumping ground for waste wood. As a protection to piles it is proposed to use bark, metal sheathing, and paints of various kinds. Some forms of concrete protection are described, and among these Koetitz pile is in favor. This pile is formed by slipping over an untreated wooden pile, a previously made reinforced concrete cylinder and driving the cylinder into the mud, the space between the wood and the concrete then being filled with sand and grout. Some of the suggestions appear rather bizarre than practical. Among the more fantastic is the proposal to explode dynamite in the water round the piles in the hope that the concussion would destroy animal life. This plan has been tried by the ingenious, but like the plan of electrolysis of the water, liberating chlorine gas, supposed to be fatal to the teredo, it has proved futile. Another arrangement suggested by the study of the habits of the borer was to construct the pile of separate planks, spiked together, so as to present from any direction the greatest possible number of cracks in order to intercept a continuous path through the pile, the belief being that the shipworm could not cross a crack. But whatever the scruples of the shipworm may be, it soon became apparent that Limnoria had none, and the plan proved to be one adopted to afford shelter rather than discouragement to intruders.

Life and History of Marine Borers

Such experiments show conclusively the need for obtaining more precise knowledge of the life history and habits of the marine borers. The committee early recognized this necessity, and selected Plymouth as a suitable site for experimental work, since the laboratory of the Marine Biological Association would be available. The investigation was intrusted to Dr. G. Barger, and Mr. C. R. Harington, the latter of whom experienced great difficulty in finding either the teredo or the evidence of its work. The reasons assigned for its absence are interesting, as they support the early views of the biologists at San Francisco, where the conformation of the coast line is similar. Mr. Harington ascribes the absence to the variations in salinity due to the inflow of fresh water and interference with the free tidal wash, which in its turn affects the quantity and character of the food supply. At Exmouth, where the docks are far up the estuary, it might be expected that teredo would be absent for the same reason, and this is the case, but at Falmouth, where the inflow of fresh water is slight and the tidal wash unimpeded by a breakwater, teredo are abundant. The observed conditions point to a possible way by which the pest might be eradicted, and the process would be a repetition of that already adopted at Hartlepool, where fresh water is periodically pumped into the timber ponds to preserve the timber intact. Evidently the degree of permissible salinity must be determined experimentally, and unfortunately owing to the want of a proper supply of food, Mr. Harington was not able to bring vigorous cultures of the free-swimming larva to the stage when they attack wood, but experiments in rearing spawning teredo in water in which the salinity was varied from 35 per cent to 5 per cent showed that the lowest limit at which larva could swim with ease was about 20 per cent. A lower percentage would probably suffice under natural conditions where the wash of the tide tended to keep the mollusc alive.

Impregnating Timber with Poisonous Substances

Another possible form of riddance which has engaged the attention of the committee is to impregnate the timber with some poisonous substance. It appears not impossible but that ordinary creosote contains some substances toxic to teredo, but these constituents of creosote are soluble in water, and are therefore soon washed out of the wood. To make the practice successful it is necessary to find some toxic substance soluble in creosote, but insoluble in water. A difficulty is here presented because the toxicity in sea water is difficult to measure, on account of the slight solubility which is essential to the problem. In some experiments with concentrations of 1:10,000, the soluble limit of the chemical employed was passed, the substance therefore remained partly in suspension and rendered the test unsatisfactory.

Certain chemicals were found to be decidedly toxic on Saxicava, Mytillus and Limnoria, and to fulfill the conditions of insolubility in water. A substance containing arsenic and used in gas warfare seemed specially suitable, and more poisonous to teredo than the tar acids of creosote. As a crucial test it was proposed to dissolve the poison in boiling creosote and to soak pieces of dried deal in it for three or four days, when a fairly even impregnation to the depth of half an inch could be obtained. Impregnation of harder woods was not attempted in this preliminary inquiry. The prepared pieces of timber with others treated with creosote, and also untreated timber, were exposed in suitable localities and examined last Christmas, but only the untreated controls were attacked slightly by Limnoria. Either the specimens were not exposed long enough or they were put out too late in the season. The experiments will be continued next year. It is not impossible, as some of the experiments seem to show, that the boring organisms possess different degrees of immunity to poisons and of indifference to creosote. In a piece of creosoted timber from which the preservative had been washed out, it was noticed that while the attacks of limnoria were confirmed to that part of the wood free from the creosote, the burrows of teredo penetrated into every part with apparent impartiality.

Hard to Treat Dense Woods

In the first report issued by the committee it was shown that the denser and more resisting kinds of timber, which, like greenheart, resist teredo attack with great success, are very difficult to impregnate, and Dr. Barger is continuing experiments to determine the best method of injecting poisons in such cases. Some of his prepared specimens are exposed at Lowestoft, where the water is very much infested with various pests. Steps, too, are being taken to send similar specimens to tropical parts where the boring effects are more rapid and more destructive. It must be remembered, however, that in any case, the toxic effect of the prepared materials cannot be expected till the unpoisoned creosote controls have been attached. With regard to greenheart, of whose endurance many instances were given in the last report, Dr. Barger, with the view of determining whether the immunity was due to its texture or its chemical composition, has had a considerable quantity of greenheart sawdust extracted by alcohol, by chloroform, and by dilute ammonia. It was found that the alcoholic extract contained an alkaloid corresponding to bebeerine, previously found in the bark, and it is proposed to have test pieces of timber impregnated with alcoholic solutions of the alkaloid, and other constituents, and also with synthetic chemicals in suitable solvents, other than creosote. The intention is to trace the action of the alkaloid upon the larval and adult teredo, with the view of ascertaining if the timber in question can by this means be rendered immune from attack.

Concrete in Marine Structures

With regard to the power of concrete to resist the action of waves, frost, and marine organisms the committee add reports on the deterioration of structures exposed to sea action. Mr. L. H. Savile treats the subject generally from the Admiralty point of view, and Mr. T. B. Hunt and Mr. G. P. Hayes deal in detail with the harbors of Portsmouth and Devonport, respectively. At those places the materials have long been exposed to sea action, and the experience gained is sufficient to enable some practical conclusions to be drawn, so far as Admiralty works are concerned. Mr. Savile insists upon the necessity of rendering the concrete impenetrable by sea water, for the percolation through the interstices will inevitably lead to destruction.

The action of the weather above high water level is also particularly noticeable in ferro-concrete structures. The vast majority of rust spots occur in this position, and particularly on the under side of beams where, through faulty workmanship, the stirrup has dropped in the mould during concreting. The Admiralty is emphatically of the opinion, that in exposed positions the least cover for reinforcement should not be less than 1½ in., and preferably 2 in., in order to allow for those partial exigencies which are inseparable from normal experience. The pounding action of the waves cannot be avoided, and good workmanship is usually sufficient protection, but the thrash of wave-borne shingle and sand may cause deterioration against which it is difficult to provide an adequate remedy. It is suggested that since air-dried concrete is the stronger and more reliable form, a desirable course of construction would be to prepare concrete in mass, or blocks, on land and transport these to the site. In a more detailed report on Devonport Dockyard, Mr. Hayes states that ferro-concrete has been satisfactory, and has withstood the action of sea organisms where the matrix has been of good quality and homogeneous throughout; but where the cement has been insufficient deterioration is rapid. Instances are given to show that piles erected sixteen years ago exhibit no signs of wear, and when the surface is broken by abrasion the interior is clean and hard, with externally very few rust spots. On the other hand, a land pier constructed of ferro-concrete in 1911 shows extensive signs of deterioration, owing to the mixing not having been continuous throughout. Fairly large pieces of the surface have broken away, exposing a very soft interior, the grains of quartz being quite free of any mortar. Further, there are many rust spots.

Effect of Workmanship

These reports show generally that the materials are apt to be better than the workmanship, and it is doubtful if the best results have yet been secured. This conclusion is supported by reports from the Bureau of Standards of the United States Department of Commerce, dealing with the structures of the Navy Yards of Boston and Puget Sound. The aim of these reports is to show how trouble can be avoided, and to insure the production of more durable work. One point insisted upon in an emphatic manner is the rapid deterioration caused by the use of too little, or too much, water in mixing the ingredients. Attention is also directed to the chemical disintegration of concrete both in hot and cold climates, and the need for radical modification in the design of reinforced concrete work in marine structures.

One great difficulty in completing these experiments is the length of time necessary for the completion of adequate tests under natural conditions, but at Boston where the variations of exposure are very severe, an experiment on the effect of varying the amount of water in concrete has been unintentionally carried out. In one of the piers, concrete of three different consistencies has been accidentally employed, and the conditions of that section of the structure where the cement and aggregate have been mixed with a medium amount of water are decidedly superior to the remainder. What other conditions may have obtained since erection are not known, but experiments are still being carried on at Boston by a private company, on a large scale. Mr. Bakenhus reports the results of a seven years' test of 24 concrete specimens, each 16 ft. in length and 16 in. square, cast horizontally and suspended vertically. Each weighs from 4,050 lbs. to 4,350 lbs., and is moored in such a way that the lower end is continually immersed in the sea, the upper end occasionally, and the central portion is subject to the alternative action of air and salt water. The composition and mixing are varied, the object being to test the effect of wet and dry mixtures, rich and lean mixtures, the use of special brands of cement, admixture with hydrated lime, addition of patents, etc. The monoliths are examined at intervals of a year, and the following conclusions have been accepted by experts. That the use of sea water in mixing is not injurious. That the substitution of 10 per cent of hydrated lime for an equal quantity of cement favored an earlier and more rapid erosion. That the addition of soft soap and powdered alum (a recommended patent) was decidedly harmful, and that 5 per cent of clay added to the cement exercised a beneficial effect on the concrete.

The third material upon which the committee proposed to experiment was steel; and Sir Hadfield reports that the preparation of the whole of the specimens intended for exposure at the various stations had been completed, and some of the consignments have been dispatched. Dr. J. Newton Friend has made himself responsible for the weighing, marking and identification of the various bars. The specimens are divided into four sections, 1, Irons (rolled and forged); II, carbon steel with varying percentages of manganese, sulphur and phosphorus; III, special steels including a 13.50 per cent chronium steel ("non-rusting" steel); and IV, hot and cold blast cast-iron. About 80 bars of dimensions 24 in. by 3 in. by ½ in. of each material have been prepared, a total in all of 1,330 bars.

Progress in Engineering

Recent Developments Outlined by the President of the Institution of Civil Engineers (British)

Dr. William Henry Maw delivered last month before the Institution of Civil Engineers his inaugural address, as president of the institution. In his address, an abstract of which appears in "The Surveyor," he dealt with the progress which has been made towards the solution of certain of these problems and with the influence of that progress on engineering work generally.

It must be recognized by all engineers, he said, that for many years past there had been steady growth in the demands for larger and larger structures and machines. Thus there was a call for bridges of longer span, prime movers of greater power and electrical plant of greater capacity per unit, and the question as to how these demands could best be met was an important one.

Bridge Design

In the case of bridges there might be regarded three ways in which increases of span might be made commercially attainable, and these were: First, by improvements in the structural design; second, by the reduction of the so-called "factors of safety" now adopted; and third, by the use of improved structural materials and constructive details. As regards the first of these alternatives there was, he thought, no great chance of obtaining material aid. Great attention had been paid for many years past to the theoretical investigation of the merits and demerits of the various types of bridges most suitable for long spans, and it was now possible to calculate with reasonably accuracy the stresses, due to certain assumed loads, to which the unit members of such bridges were exposed. It certainly did not appear likely that any new type would be evolved possessing striking advantages as compared with those already known.

As regarded the second alternative, the prospects were better. The allowances made under this head might be divided into two classes, first, those due to uncertainties as to the stresses to which the structures might be exposed, and, second, to uncertainties as to the qualities of the material used and of the workmanship. These two classes of allowances were perfectly distinct in character and had to be considered independently. Allowances of the first class were those—such as stresses due to wind pressures and changes of temperature, &c.—which depended largely on local circumstances, and they must therefore always be matters to be decided by the individual judgment of the engineer responsible for the structure, so that a reduction in them could not be calculated upon. Allowances of the second class, on the other hand, came under a different category. They were allowances which would not be required at all if we could be absolutely certain of the quality of all the materials used and of the soundness of the workmanship, and there appeared to be good reasons for believing that, under existing conditions, their amounts might be materially reduced as compared with those considered necessary even ten years ago.

During that period vast improvements had, on the one hand, been made in our steel manufacturing processes, and especially in the direction of securing uniformity of quality, while, on the other hand, the facilities for thorough testing and inspection had been enormously increased. It was thus only reasonable that advantage should be taken of these facts to decrease the allowances under consideration. An additional reason for such action was also afforded by the great improvements which had been made in the plant of the chief bridge-building firms both at home and abroad, improvements which had resulted in securing a materially higher class of workmanship.

We now come to the third alternative—namely, the case of improved structural materials. There had, of course, already been great progress in this direction, but there were no indications that we had reached the limits of such progress. It must be remembered that he was speaking now of those structures, such as long span bridges, in which the weight of the structure itself formed the larger portion of the total load supported. In such structures the importance of the property of the material denoted by the term "specific tenacity" was exceedingly great and the successful manufacture, on a commercial scale, during recent years of various high quality alloy steels had quite changed the aspect of affairs and had materially enlarged the limits of the practically permissable spans of the different types of bridges. For instance, in the case of the proposed cantilever bridge of 1,600 ft. span at Sydney, the specification for which was issued last year, the tensile stresses permitted for carbon steel were 20,000 lb. per sq. in. for eyebars, and 18,000 lb. per sq. in. for riveted members, while for nickel steel or chrome nickel steel these stresses were increased by 40 per cent, or in the case of pure tension, 45 per cent.

If we took the lower of these permissible increases and applied it to the case of a bridge of such design and span that if constructed of carbon steel the weight of the structure would be four times that of the useful load carried, it would be seen that for every 4 tons of carbon steel replaced by nickel steel there would be approximately a saving in weight of $4-\frac{4}{1.4}=1.15$ tons, which could be turned to account by adding to the permissible useful load carried or by revising the design of the bridge so as to reduce the weight of the structure as a whole. He had said approximately, because, although in the case of members subjected to pure tension the full effect of the greater strength of the nickel steel could probably be realised, this would not be so with all the members subject to compression, as the reduction of scantlings resulting from the employment of the stronger steel would in some cases, by altering the ratio of length to the radius of gyration, modify the amount by which the cross-section of the material could be reduced. Making allowance for this, however, the effect of using the higher class material would be most important.

Prime Movers

Prime movers formed the subject of a later section of Dr. Maw's address, and he recalled in this connection that at the time the "James Forrest" lecture, to which he had referred in opening, was delivered, the steam engine was rather "under a cloud." In fact, a very eminent member of the institution did not hesitate to say that it was quite open to question whether engineers would not act wisely in giving up efforts to improve the steam engine and devote their energies to the development of the internal-combustion engine, which he regarded as the prime mover of the future. Fortunately, however, this view had not been generally adopted, and as a matter of fact the development of our steam-driven motors during the past eighteen years had been as great, if not greater, than in any similar period since the time of Watt. When he spoke of developments he did not refer solely to increases in thermal efficiency. He by no means underrated the importance of such efficiency, but at the same time he recognized that it was, to a certain extent, subservient to other qualifications. What a user of steam power desired was to obtain that power at the least possible overall cost, including not merely the expenditure on fuel, but also the outlay on attendance and maintenance, together with the interest on the amount expended in his installation of the plant and proper allowance for depreciation.

In determining the best course to be adopted for the provision of motive power in any particular case, many points had to be considered. Much depended upon the nature of the load, regular or otherwise, and upon the number of hours worked per week, and there were not wanting exceptional cases in which a single non-condensing engine of thoroughly good design and workmanship would prove more economical than the highest class of compound condensing engine. Whatever the class of engine used, however, it was important that the steam consumed should be produced at a cost which was the least possible for that particular case. In large installations, such as those of our chief power-stations, important economies in labor charges had for many years past been effected by the adoption of mechanical stoking and the introduction of efficient appliances for handling coal and removing ashes, etc. Plants of this kind had been greatly improved during recent years, and the results of its use must be taken into account in considering the present status of the steam engine as compared with other classes of motive power.

There were a very large number of other directions in which advances had been made in recent years—all tending to extend the powers of the engineer; but with most of these it was impossible to deal in any way on the present occasion, while others he could only briefly mention. Among the latter, relating chiefly to mechanical engineering, might be included the great development of grinding machines which enabled extreme accuracy of workmanship to be attained with very moderate expenditure, the introduction of oxy-acetylene cutting and welding processes and the further improvements in steel for high-speed cutting tools; while the civil engineer had been benefited by the production of excavating and tunnelling machines, mechanical appliances for the construction, repair, and maintenance of roads, dredging plant, and pumping machinery, all having powers of output scarcely imagined a few years ago and all tending to reduce cost.

The Future

It would, he thought, be evident from the facts he had put before them that, in spite of disturbances caused by the war, recent years had, so far as engineering knowledge and practice were concerned, been years of most substantial progress from both the theoretical and practical points of view. Extensive and careful researches had materially increased our knowledge of the properties of steam and also of the actions which took place in the cylinders of internal-combustion engines using gaseous or liquid fuel, and had so rendered possible most important advances in the economy of our chief prime movers. The range of constructive materials available for the various purposes of the engineer had been enormously enlarged, and—what was quite as important—the qualities of these materials and the proper methods of their treatment had been defined with an accuracy which vastly increased their usefulness. In some directions, too, entirely new fields have been opened out for the employment of the engineer.

Bearing these facts in mind there was, it appeared to him, but one conclusion which could be drawn—namely, that the profession had before it a most brilliant future. Engineers had carried out great works in the past, and they all had most sincere admiration for their early predecessors, who, with sparse data to help them, a very limited choice of structural materials, and often working with more or less crude appliances, secured most admirable results. Again, in the present day engineers were in an almost endless number of directions carrying out work which might be regarded as the basis of our civilization, and which was conferring untold benefits on mankind; but in the future we might justly expect that they would accomplish even greater things.

In considering the researches which had been carried out and the advance which had been made in recent years, there was one fact which appeared to him to be of far greater importance than all others. It was this; in none of the researches referred to, varied and extensive as they had been, was there the slightest trace of finality. Much as had been discovered, and great as had been the progress made, it was most certain that they have at present only effected the preliminary opening up of the mine of knowledge, and that the real wealth of its contents was as yet unknown to them. So far as they had gone, they could only say that the "impossibilities" of yesterday had become the "possible" of to-day, and in the early future many of these "possibilities" bid fair to become accomplished facts. Surely this was a great inheritance, which should incite the coming generations of engineers to make most strenuous efforts to secure greater and still greater developments, so that they might, in their turn, leave behind them a heritage more glorious still.

J. S. D'Appolonia, contractor and retail lumber dealer, Coleman, Alta., has been awarded the contract for a new skating arena at Coleman. It will measure 100 by 200 ft., and be of frame construction with concrete foundations and steel trusses. The estimated cost is $15,000.

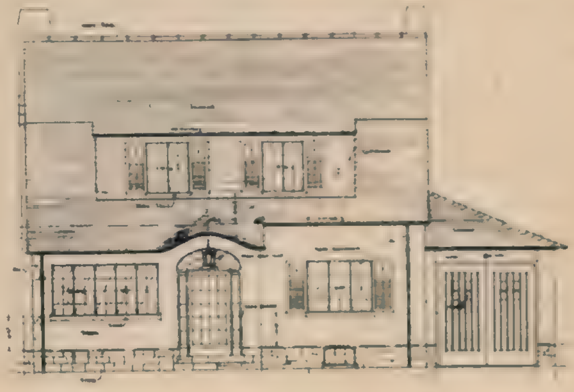
The Contract Record's

Weekly House Suggestion No. 47

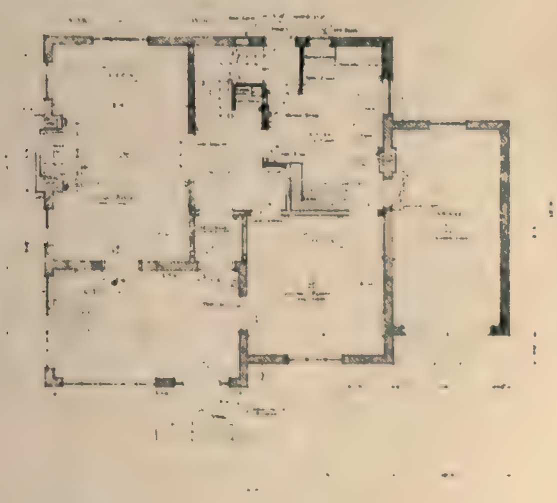
The subject of our series this week is a residence, on modified Dutch Colonial lines, built in the Lawrence Park district of Toronto. This house has an especially attractive front, the reddish brown shingle roof and the variegated colored stone base lending a pleasing touch of color to the white stucco walls. The main feature of the front, however, is the beautiful main entrance, the frame of which is wood, the roof being carried down and arched, forming a canopy over the door. A wrought iron lamp is suspended over the door, as seen in elevation. The walls are stucco on interlocking tile and clapboard is used around the bedroom windows at the front and back. All windows are of the steel casement type.

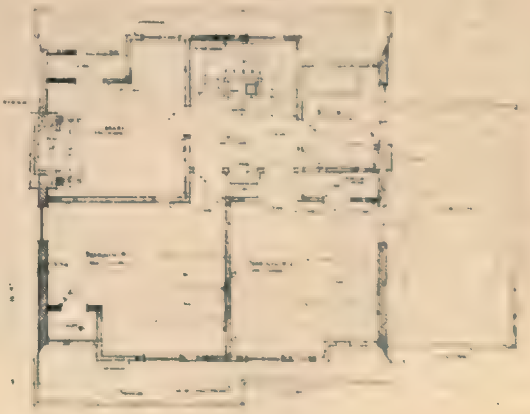
The front entrance is on a heated loggia, floored with a reddish cement, blocked off in tile design. There is direct entrance from the loggia on the large living room, on the dining room and also on the hall. The feature of the living room is a beautiful stone mantel of Tudor design in the side wall. The main staircase is situated at the rear of the hall, yet readily accessible from any of the rooms. The kitchen arrangement is ideal, as a glance at the plan will indicate, having entrance on the dining room, garage, hall and to the rear. The floor here is of pine and the trim gumwood, finished in white enamel. Many modern built-in features are included in the kitchen equipment—ironing board, refrigerator with provision for icing from the outside, cupboards, etc. The flooring downstairs, with the exception of the kitchen, is quarter cut oak and the trim is gumwood, finished walnut.

There is a large square hall upstairs, with direct entrance on the two large bedrooms, bathroom and library, the latter room being equipped with a handsome brick fireplace, as seen on plan, trimmed with wood. The flooring upstairs is of plain oak, with the exception of the bathroom, which is tile. The trim is gumwood finished walnut, as on the first floor.



There is a full size basement, containing boiler room, septic tank, laundry, coal space, etc. The ceiling of the basement is plastered. The garage to the right, as seen on plan, has interior plastered walls and is finished on the outside to match the general construction and trim of the house. Mr. Maurice D. Klein, architect, of 71 King St. W., Toronto, designed this beautiful home.





Mainly Constructional

East and West—From Coast to Coast

Mayor Greb and Alderman Bucher officiated at the ceremony of breaking the ground for the new city hall at Kitchener, Ont. A plow was used, Mayor Greb driving the horses and Ald. Bucher guiding the plow. The contractors will rush through the foundation work before the real cold weather sets in.

The Beechnut Packing Company has decided to establish a plant in Canada, at Hamilton, Ont., to take care of its Canadian trade, and, although it is said that the new plant will be of modest capacity, considerable acreage has been purchased for future expansion.

Ratepayers at Galt, Ont., will vote on a by-law for a new $360,000 collegiate institute and technical school, at the next elections. The Minister of Education has approved of the plans and the council gave the bill its final reading at a recent meeting.

The National Meter Co. Ltd., of New York, has leased the premises at No. 151 Duchess St., Toronto, for a term of five years, and the premises will be altered for the manufacture of water meters. Manufacturing is expected to commence next February.

At a gathering of about 50 doctors of the Border cities, at the annual dinner of the Essex County Medical Society, held at the Essex County Golf Club recently, a resolution was passed favoring the proposal for a joint filtration system to serve the border municipalities, which is to be voted on by the ratepayers at the approaching elections.

The first sod for the $200,000 Varsity Memorial Tower at the University of Toronto was turned a few days ago. The tower will be about thirty feet square at the base and will be modelled on the style of the tower at Magdalen College, Oxford. The plans include the installation of a clock and a carillon of bells. It will be connected with Hart House by means of a stone screen and with the main university building by a cloistered arcade. On the west wall of the arcade will be placed tablets with the names of the fallen and directly over the roadway will be a war record room. There will be two arches over the roadway, one for vehicles and one for pedestrians.

It is estimated that the total cost of abolishing level crossings on Grand Trunk lines, within the boundaries of Montreal, at the present time would be $24,000,000. This is a question which has been under discussion by the city for the past twenty years and an aldermanic committee propose studying the problem thoroughly in the near future. This cost includes the elevation of the tracks, estimated now at $18,000,000 and the re-location of Bonaventure station and erection of other buildings, $6,000,000.

The council of the St. John, N. B., Board of Trade is advocating the erection of a building large enough to provide adequate and suitable accommodation for the Natural History Society and its extensive museum, the St. John Arts Club and its studios and art classes, the New Brunswick History Society and its records, and for the safe-keeping of civic archives.

Representatives of all interested Ontario municipalities have been asked to attend a meeting of the legislative committee on town planning to be held at the Parliament Buildings, Toronto, on December 7. The meeting will be for the purpose of discussing the draft bill presented by the town planning convention after its session here a few weeks ago. The chief item of interest is the clause in the proposed bill which makes it necessary for municipalities to provide a tenth of a mill in their tax rate for the work of their town planning association. The committee has abandoned its plan to visit Haileybury as Hon. W. E. Rollo, the chairman, considers that they could not accomplish a great deal there at the present time.

The Canadian National Railways terminal at Port Arthur and Fort William is at present under active construction, about 300 men being employed on this work. The 300 acre site is located in Neebing township, just west of Fort William. The terminal is being laid out in such a way that additional accommodation can be provided as needed. It will be provided with a gravity classifying system of 20 tracks. The yard will consist of three units; the receiving yard, classifying yard, and the third for making up westbound trains. A brick and steel roundhouse is being constructed, with four sections, each of which will have six stalls. Concrete engine pits and modern facilities in every detail are provided, to make for efficient transportation. Water, sewage and electric power facilities are being installed. The new terminal will be finished, it is anticipated, in plenty of time to handle the 1923 crop movement.

Ground was broken a few days ago by the Quebec Harbor Commission in preparation for the construction of a gigantic shed along the front of the St. Charles Basin. This shed, which will cost in the neighborhood of $200,000, and will extend over a considerable portion of the basin front, will be used in connection with the loading and unloading of the Canadian Pacific liners next season. Work will be prosecuted vigorously on the construction of the shed, and it is understood that in consequence of the decision a large number of the harbor employees will be assured of employment. The shed now under construction will be one of the largest and most modern on the continent.

Personal

Messrs. Page & Warrington, architects of Toronto, have moved from 95 King E. to Room 214 Confederation Life Building.

Obituary

Mr. Harry H. Wickwire, Minister of Highways, Nova Scotia, died suddenly at his home at Kentville, N. S., a few days ago. Deceased, who was in his 55th year, was elected to the Nova Scotia legislature in 1894 as Liberal representative for King's County and retained his seat, with the exception of one term, since that time.

Mr. Maurice Verge, architect of Quebec city, died at his home in that city a few days ago, following a long illness. Mr. Verge was but twenty-seven years of age and entered on the practice of architecture in the year 1917. After graduating from the Montreal Polytechnical School with the highest honors, he opened an office in New York, but was obliged to return to Quebec some time later on account of ill health.

Mr. Felix Labelle, of Ste. Rose, P. Q., and well-known in Montreal building circles, died a few days ago after a long illness. Deceased was very prominent as a builder in Montreal at one time and was connected with the construction of several fine buildings in Quebec province, including the old Windsor Station, La Presse Building, in Montreal, and Chateau Frontenac at Quebec.

The Dominion Water Power branch of the Department of the Interior, J. B. Challies, C. E. director, has just issued "Water Resources Paper No. 34" dealing with the St. Lawrence and Southern Hudson Bay drainage.

ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U. S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, December 13, 1922 No. 50

A Man Big Enough for the Job

The outstanding event of the past week was the arrival in Canada of Sir Henry Thornton, the new president of the Canadian National Railway System and his general statement of policy as outlined at his first public appearance at a banquet given in his honor by the Montreal Board of Trade.

It was not to be expected that matters of policy would be outlined at this early date, but that Sir Henry would take the first opportunity of enunciating the basic principles upon which the National system would be operated was naturally looked for. The definiteness of the enunciations will leave no doubt in the public mind on two points: (1) That he has already grasped the fundamentals and (2) that, having outlined his general plan, he will adhere to it.

What the people of Canada have been hoping and praying for is a man with sufficient ability and strength of character to assume just as absolute a dictatorship of the nationally-owned lines as is exercised, for example by President E. W. Beatty for the C.P.R. The theory of national ownership is sound enough. The difficulties lie in practice. We must all recognize that in addition to the usual and inevitable problems to be solved in the administration of an enterprise of such dimensions and complexity—common to both private and government ownership—there are innumerable snares besetting the pathway of the man who is constantly being importuned, at the same time, to steer his course according to the dictates of this or that political or sectional influence. The people of Canada know by experience, and it is gratifyingly evident that Sir Henry Thornton also knows, that such a course spells failure.

Two main points were brought out in Sir Henry's address. The first was that he looked upon the Canadian National Railway System as differing, fundamentally, only in minor detail from the C.P.R.—the number of shareholders. Shareholders of the C.P.R. number thousands; there is only one shareholder of our national system—Canada. Further than this, his relation to his single shareholder was almost identical with Mr. Beatty's relationship to his thousands of shareholders—he had been given carte blanche, absolute administrative control.

The other point made by Sir Henry, and most emphatically made, was that there would be no political interference. His words in this respect are worth quoting:

> **"But let it be emphatically understood now—once and for all—that there is to be no political interference, direct or indirect, in the administration and working of the Canadian National Railways. I cannot put it any more forcefully without transgressing the rules of polite speech, and if I knew of any words which would make this point more clear I would unhesitatingly employ them. The prime minister has solemnly assured me that there is to be no political interference, and it was with this distinct understanding that I accepted the post which the government has done me the honor to offer. This assurance is the only assurance that any government, irrespective of political complexion, would be compelled to make under similar circumstances. It is vital to the success of our railways, and any other procedure spells inevitable disaster."**

Of course we have all heard this kind of talk before and we all know, in spite of such protestations, how fatal to many of our publicly owned enterprises the interference of "politics" has proven. Some way or other, however, Sir Henry looks, and his words are phrased, as if he means what he says. If he does, and if he has a sufficiently strong character to stand or fall on that declaration, he will find that, irrespective of political inclinations, or racial or sectional aspirations, the people of Canada will stand behind his efforts and give him their moral support.

Another ray of sunshine shone in upon this eventful gathering in the statement by Sir Joseph Flavelle that there will be no operating loss on the Canadian National System this year. Not only will operating charges all be met but there will be a "substantial" surplus to apply to fixed charges. As Sir Henry Thornton expressed it, this is an evidence that the system will "respond to treatment."

From a national point of view we look upon Sir Henry Thornton's active assumption of the control of the Canadian National Railway System as an epoch-marking event. Canada is in the making and whether, in the near future, she shall be counted "big" among the other nations of the world depends in great measure on her transportation systems. Thornton and Beatty hold the keys to the situation and Canadians look to them, and expect them to make good.

Building Expansion Proceeding at an Accelerated Pace

The revival of residential construction this year has overshadowed everything else in the building field. But there has also been another revival that is very significant. Industrial construction this year has totalled 23 millions, compared with 16 millions in 1921. This increase, although it has not yet assumed large proportions, seems to indicate a substantial revival in this class of building. All types of construction contracts awarded during the eleven months of 1922 amounted to $259,371,400, compared with $221,014,800 in the same period of 1921, being an increase of 17.3 per cent.

During November, construction contracts awarded in Canada, according to MacLean Building Reports, Limited, amounted to $21,453,900, compared with $16,639,800 in November 1921. Residential building accounted for 36.6% of the November total and amounted to $7,864,800. Business building amounted to $7,065,700, or 32.9%; industrial building $743,600, or 3.5%; public works and utilities $5,779,800, or 27%. The value of contemplated new works reported during November amounted to $24,902,100.

The cost of building continues to advance slightly. The activity of the past season, occupied with the coal and rail difficulties, tended toward a firming of prices, but it is confidently expected that with the resumption of normal conditions in the building field, a greater volume of production will replenish the stock of building material dealers and re-establish prices for spring building activity on a basis comparable with the similar period of 1922.

It is quite certain that many projects are now being overhauled for the 1923 building period, and in every section of the community architects are reporting an increase in planning activity, and every office looks forward confidently to a busy season during the coming winter in preparation of the spring building. The building of moderate cost homes will undoubtedly be resumed actively early next year.

Good Roads Develop the National Spirit

The potency of the good roads movement as a promoter of interprovincial good feeling and the all-Canadian spirit received striking exemplification in the visit which Hon. J. L. Perron, in his dual capacity of president of the Canadian Good Roads Association and Minister of Highways for Quebec province, paid to Ontario as the guest of Hon. F. C. Biggs, Minister of Public Works and Highways, in the middle of November. The visit was a sequel to the interprovincial conference on roads held in Montreal, in October, and attended by the ministers of roads and their officials from practically every province in the Dominion. Hon. Mr. Biggs on that occasion extended an invitation to his Quebec confrere and other chief officers of the Good Roads Association to make a tour of inspection of Ontario's highway system, and the recipients of the invitation gladly availed themselves of the opportunity. They were well repaid, first by the knowledge gained of what Ontario is doing in the creation of a comprehensive and most modern highway system, and secondly by the cordiality of the welcome extended to them everywhere as the representatives of the sister province. It was a happy augury of the close knitting of national ties as the gradual extension of the network of good roads throughout Canada links province with province in a more general interchange of personal intercourse and motor-drawn communications.

Building Costs Reduced by Year-Round Construction

A rather interesting work was recently undertaken by the New York Building Congress tending to initiate a program to reduce the cost of building by adding more seasons to the industry, thereby eliminating both the rush periods when bonuses are frequently paid and the periods of unemployment. A survey has just been completed analyzing the building situation. The findings are such that it is believed with the co-operation of all the elements contributing to the building industry a workable program can be put in operation that will be a material benefit to every phase of society from the laborer to the investor.

In summarizing its investigation the congress finds that custom is really the biggest influence in causing the peak loads on the demand for labor, especially during the renting seasons. Careful business foresight is what is needed more than anything else to effect lower costs, with less waste, higher quality of workmanship and greater production, according to the reports.

In prefacing a detailed statement of recommendations for adding more seasons to the building trade, the New York Building Congress Bulletin states:

"While the congress feels fully aware of the fact that an entire cure for seasonal employment is impossible on account of weather conditions, opportunity for investment, emergency and the will of the owner and speculator, still the opinion is general that much can be done to adjust elements that affect peak demands and as a result decrease much of the unnecessary cost and loss to which the building industry is now subjected.

"With this understanding the following recommendations are made in hope that they will be suggesting to owners, investors, real estate brokers, architects, engineers, material manufacturers, contractors, labor and others who may be interested in reducing costs and eliminating unemployment periods:

"1. Establish a wider range of rental period dates.

"2. Regulate government, state, city, religious and educational building construction so that it will come during the low period of the employment wherever possible.

"3. Regulate the construction of new buildings and additions that are erected for owners' prearranged occupancy without regard for investment returns so that it will come during the low period of employment.

"4. Encourage beginning work on new construction March 1 instead of the customary date of May 1, thereby bringing its labor demand two months ahead of the demand peak, with a greater supply available.

"5. Plan maintenance and repair work so that it will come during the season for which there is a low demand for the labor involved, subject to emergency conditions that must be considered.

"6. Whenever possible, adapt the demands for 'inside' and 'outside' work to labor available."

Is Day Labor Cheaper than Contract?

The Claim is Often Made that Time Work is More Economical—The Only Way to Determine is to Have a Record of Costs—Should Public Bodies be Compelled to Publish Day Labor Figures?

Do you think that public bodies doing work by day labor should be compelled to publish on the completion of the work a true itemized account of the cost, including proper overhead and the time of all think that such a procedure would help to expose the fallacy of the day labor system. The claim is often made by officials doing work by day labor that work can be done more economically by that system than by contract. Many contractors, on the other hand, claim the facts are otherwise; but it is difficult, if not impossible, to ascertain the real cost of any given project constructed by day labor from the records as now kept, and their value as a comparison to the cost of the same work by contract is valueless.

For this reason, Associated General Contractors of America have prepared a bill which has as its object the enforced publication of costs on day labor jobs. Possibly something of the sort could be applied to Canadian conditions and for that reason this model bill is reprinted herewith:

An act to require municipalities and political subdivisions of the province of .... to keep complete and accurate accounts of all public work and construction and of the cost thereof, done for or on behalf of such municipalities and political subdivisions.

Be it enacted by the legislature of the province.

Section 1. Whenever a county, city, village, borough, school district or other political sub-division, of the province of ...... or any public agency of such municipality or political sub-division, shall determine that any public work or construction is necessary to be done, either by contract or by day labor, or otherwise, an estimate of the cost thereof shall be made, and if such estimate shall exceed the sum of fifteen hundred dollars ($1,500) the total amount of such estimate shall be published in the official newspaper of such county, municipality or political subdivision. If there be no such official paper, the same shall be printed in a legal newspaper of the county in which the work is to be done. If the estimated cost of such public work or construction exceeds the sum of fifteen hundred dollars ($1,500), such municipality, political sub-division or public agency shall publish the estimated cost of such project at least fifteen days prior to the awarding of a contract or before the beginning of construction work thereon in the event the work is to be done by day labor or otherwise and shall keep and preserve an accurate record and account of such work and construction and of the cost thereof.

Provided, that where such estimate is publishedl as part of the official proceeding of the governing body of such municipality, public agency or political subdivision, no further publication shall be required under the provisions hereof.

Section 2. The said account shall show in accurately tabulated form, under appropriate heads, the totals of all classes, kinds and descriptions of work performed and of materials entering into such public work or construction, and the cost to such municipality, political sub-division or public agency of each, including the cost of all materials, supplies and services furnished or paid for by said municipality, political sub-division or public agency, and the cost of all labor, when said work or construction is done, by day labor, when such public work or construction is done by contract the prices paid to the contractor for, and the amounts paid to him for each class, kind or description of work performed, and materials furnished; and in all cases, the cost of all overhead, the cost of engineering, and all other expenses involved in the total cost of such public work or construction, which total shall be tabulated and distinctly shown.

Section 3. The total cost of such public work or construction together with a statement of the estimated cost upon completion thereof, shall be published in a legal newspaper in the county, city town, borough or school district in which said work is done,

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Comparative Statement of Contracts Awarded in Canada

According to Geographical Divisions	Ontario	Quebec	Maritime	Western	Total
November, 1922	$ 12,706,300	$ 7,107,100	$ 223,500	$ 1,417,000	$ 21,453,900
November, 1921	11,825,000	3,276,100	342,300	1,196,400	16,639,800
November, 1920	3,902,800	3,453,900	1,251,300	6,791,200	15,399,200
November, 1919	7,481,100	4,983,700	1,166,500	3,323,900	16,955,200
11 months, 1922	142,677,500	61,412,600	9,897,900	45,383,400	259,371,400
11 months, 1921	104,895,100	58,341,600	7,942,800	49,835,300	221,014,800
11 months, 1920	106,134,500	50,469,000	21,001,800	69,253,700	246,859,000
11 months, 1919	82,507,500	53,345,200	18,123,900	27,362,300	181,338,900

According to Classifications or Types	Residential	Business	Industrial	Engineering	Total
November, 1922	$ 7,864,800	$ 7,065,700	$ 743,600	$ 5,779,800	$ 21,453,900
November, 1921	7,503,200	3,873,300	1,160,700	4,102,600	16,639,800
November, 1920	3,137,900	3,591,900	2,409,600	6,259,800	15,399,200
November, 1919	4,591,300	5,033,700	6,055,000	305,000	16,955,200
11 months, 1922	97,675,200	74,495,400	23,232,700	63,968,000	259,371,400
11 months, 1921	72,169,400	80,305,700	16,029,600	52,510,100	221,014,800
11 months, 1920	53,368,700	83,244,100	64,281,200	45,965,000	246,859,000
11 months, 1919	44,390,100	56,304,200	54,634,100	26,315,500	181,338,900

if there be such newspaper published therein. If not, then in some legal newspaper published at the county seat of the county in which said work of construction is performed.

Section 4. The records and accounts hereinabove required to be made and kept, shall be open to inspection by the public at all reasonable times. Certified copies thereof shall be furnished to any citizen of the province on demand, on payment of the legal fee for making and certifying the same.

Section 5. This act shall take effect and be in force from and after its passage.

Progress in the Scientific Study of Portland Cement*

Its Chemical Composition and the Reactions that Take Place During Calcination and Hardening Are Now Well Understood—Still Need for Further Study in Order that the Best Cement May Be Obtained

By S. B. Newberry, President, Sandusky Cement Co.

The past twenty years have witnessed the practically complete solution of the long-debated questions of the chemical constitution of portland cement clinker, the reactions which take place in the calcination of cement material, and the nature of the compounds formed in the process of setting and hardening. For more than a hundred years these reactions remained obscure. The Romans made mortar by mixing slaked lime with the sand most readily available, which was a volcanic scoria called "Pozzuolana," and found that such mixtures gained great hardness and were capable of hardening under water. We now know that this was due to reaction between the lime and the soluble silica contained in the volcanic sand, and that many other materials such as slag and burned clay have similar action. This volcanic scoria was used as an ingredient of mortar and concrete for eighteen hundred years, with little knowledge of the causes of its action. Smeaton, engineer of the Eddystone lighthouse, in 1755 made a study of different kinds of lime with regard to their suitability when mixed with pozzuolana for mortar which would harden under water. He found that limes containing a considerable portion of clay were the most effective, and stated "I do not doubt to be able to make a mortar equal to portland stone." From this remark the name of portland cement is derived.

Le Chatelier's Investigations

Smeaton's observations received little attention, and for seventy-five years thereafter various notions were held in regard to the cause of hardening. Bergmann, a Swedish chemist, attributed the hardening to the presence of traces of manganese, and this view appears for a long time to have been generally accepted. Vicat in 1818 made a thorough study of hydraulic materials and fully confirmed Smeaton's observations that this is due to the presence of clay in the limestone from which the lime is made. He showed that by burning artificial mixtures of lime and clay, products having hydraulic properties could be made, and that these properties are due to combination of the silica of the clay with lime. Later investigators arived at more precise knowledge of the nature of ths combination, but it was not until the problem was attacked by Le Chatelier in 1887 that a complete explanation of the nature of cement clinker and the hardening of cement was given. The writer called on Le Chatelier in 1913, who stated that his grandfather was a great friend of Vicat, and that when Le Chatelier selected a subject for his thesis for the degree of Doctor of Science, the samples of cement made by Vicat which had been carefully preserved by his grandfather, aroused his interest and led him to choose the subject of hydraulic cements for his investigation.

Le Chatelier showed that the chief constituents of cement clinker are tri-calcium silicate and tricalcium aluminate; that is to say, three molecules of lime combine with one molecule of silica and alumina, respectively. When cement is ground and mixed with water, these substances form hydrated crystalline compounds, hydrated calcium silicate, hydrated calcium aluminate, and calcium hydrate, and it is because of this crystallization that cement hardens. It is interesting to note that the conclusions reached by Le Chatelier thirty-five years ago, although often disputed, are now firmly established.

After the days of Le Chatelier the scene of successful scientific investigation of cement shifted to this continent, and the great work which has been done in this field in recent years has been that of Day and Shepherd, and Bates of the U.S. Bureau of Standards, and Rankin of the Geophysical Laboratory. By the use of modern methods and appliances which had not been developed in the days of Le Chatelier, these American investigators have been able to give exact proof of the nature and properties of the constituents of clinker, and of the crystalline substances formed in the hardening.

Modern Developments

The chief point of dispute in regard to Le Chatelier's conclusions has been the existence of tri-calcium silicate. Le Chatelier, Day and Shepherd were unable to produce this compound by calcining mixtures of pure lime and silica, even at very high temperatures, and Day and Shepherd reached the conclusion many years ago that it did not exist. The later investigations of Shepherd, Rankin and Bates have shown that this tri-calcium silicate is formed in the presence of very small amounts of alumina, boracic acid or chromium oxide, and that it is actually present in considerable quantity and in definite crystals recognizable with the microscope in portland cement clinker. This clinker consists, as most clearly set forth by P. H. Bates of the Bureau of Standards (Journal of the Franklin Institute, March, 1922), of tri-calcium silicate, di-calcium silicate and tri-calcium aluminate. The other materials present, chiefly magnesia and iron oxide, are in the form of a non-crystalline flux or glass which is present in small quantity, containing more or less silica, alumina and lime. Bates has been able to prepare these principal constituents in a condition of practical purity, and to study their properties, including the strengths developed in their hardening. Tri-calcium silicate has all the properties of portland cement and shows high strength, especially at short periods. Di-calcium silicate, containing less lime than the tri-silicate, is very slow in hardening, but develops high strength at long periods. The tri-calcium aluminate sets almost instantaneously and contributes but little to the strength. The best cement appears to be that containing considerable proportions of both of the lime silicates, thus developing early strength and continuous gain at long periods. By increasing the lime it is possible to make clinker consisting chiefly of tri-calcium silicate with little or no di-calcium silicate. Such clinker requires however a very high temperature in burning, and appears to possess no qualities which would justify the greater cost of making. These observations throw clear light on the practical problems of cement making and fully explain what proportions of constituents are most desirable from the point of view of quality of product and cost of manufacture. One of the most significant practical suggestions is given by Rankin (Journal of Franklin Institute, June, 1916), first stated by Richard K. Meade, that there are three factors in making clinker which tend to bring about equilibrium and the production of the largest amount of active hydraulic constituents. These are:

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*From "Progress Review of Twenty Years," issued by the Portland Cement Assocation in commemoration of its twentieth anniversary meeting.

First: Fineness of grinding of raw materials.
Second: Temperature of burning.
Third: Length of time of burning.

How Good Can Cement Be?

Increase in any one of these will overcome deficiency in the others; for example, extremely finely ground raw material will combine at lower temperature and in shorter time than coarse raw material. Higher temperature or longer duration of burning may replace extreme fineness of raw grinding. This is very significant and has a practical bearing on the manufacturing process. From a practical point of view, there is still much to be done to answer the question, "How good can portland cement be?"; that is, what strength, resistance to abrasion and other desirable qualities can possibly be developed by exact proportions of material and best possible raw grinding and burning?

The writer hopes most earnestly that the Portland Cement Association may take a more active part in the investigation of problems of this character. Their laboratory has already done an immense amount of valuable work on the best methods of using cement, the proportioning of concrete, the prevention of destruction by alkali waters, and along many other lines, and in these fields has done scientific work of the highest value. It has yet, however, because of the many other problems it has had to study, been unable to take much part in the scientific study of cement manufacture or of the chemical composition of clinker and the reactions in the hardening of cement. As these problems intimately concern the industry, the association laboratory will no doubt extend its work in these fields.

The subject of the hardening of cement through its crystallization by combining with water has been ably investigated by Klein and Phillips of the Bureau of Standards (Technologic Paper No. 43, 1914). They have shown that this crystallization consists of the formation of hydrated tri-calcium aluminate, calcium hydroxide in hexagonal crystals, and non-crystalline (amorphous) hydrated calcium silicate. It is interesting to note that these observations confirm almost completely the conclusions advanced by Le Chatelier in 1887, although through further study and the use of exact modern scientific methods they have greatly expanded and clarified our knowledge of the process of hardening.

Letters to the Editor

Favors Early Award of Road Contracts

Toronto, December 1, 1922.

Editor, Contract Record,

We notice your editorial entitled "Early Award of Road Contracts" in the Nov. 29 issue of "The Contract Record." This is good advice for the government and municipalities, and they should see that a policy like that is all to their advantage. Even then the contractor has to take big risks in preparing estimates in winter, stocking up and forseeing labor conditions, but this will be more than counterbalanced, if the action you suggest is established.

Yours truly,
A. W. Godson,
Godson Contracting Co., Ltd.

Surface-Area and Water-Cement Theories of Concrete Proportioning Should not be Condemned

Toronto, Dec. 1, 1922.

Editor, Contract Record,
Toronto.

I cannot let pass without comment, Prof. G. M. Williams' paper, "What is Wrong with Most Concrete Proportioning Theories?" which appeared in your issue of October 11, page 995. The assertions he makes there are not new but because of the dogmatic way in which his statements are presented, they would lead one to believe that the claims he has made are established facts. This is far from being the case.

In June 1918, Mr. L. N. Edwards, then with the city of Toronto, presented his method of proportioning the materials of mortars and concretes by surface area of aggregates. In December of the same year, Prof. Duff. A. Abrams of the Lewis Institute, Chicago, brought out another method of proportioning concretes based on fineness modulus and on what is now known as the water-cement ratio theory. In July 1919, Prof. Williams and Mr. Watson Davis, both of whom were then connected with the Bureau of Standards, Washington, D. C., published an article in which they criticized strongly both the conclusions and test data of these two methods. Supporting their claims were the results of tests made by themselves. These criticisms were answered by Messrs. Edwards and Abrams and commented upon by others. Since then other papers on the subject of these theories have been published but without much new information on the subject appearing.

I will not attempt to review the details of this controversy or to express any opinions on its merits but I would call attention to the fact that Prof. Williams is the only critic to come forward and condemn in their every feature both methods of proportioning; to express doubt as to the authenticity of the data on which they are based, and to claim that sound principles of testing were violated in obtaining this data. Attention is also directed to the fact that the frequent references by Prof. Williams to published articles as supporting his opinions are without exception to articles written by himself and the tests referred to are tests made by him and his association.

The criticisms which have been made by Prof. Williams have been answered by both Mr. Edwards and Prof. Abrams and their replies are fully as convincing to the average reader as are the former's arguments and criticisms. With the exception of the fact that neither Mr. Edwards nor Prof. Abrams used the flow table in their early tests, the methods pursued by them are those recognized today amongst testing engineers as "sound in principle" while consideration of their writings does not lead one to the conclusion that they were not as fully conversant with and had a proper appreciation of the fundamentals of testing.

The Hydro-electric Power Commission of Ontario, with which the writer is connected, has been successfully using methods of proportioning based in part on the theories of both Messrs. Abrams and Edwards. Consequently we have become involved occasionally in the controversy which has resulted from Prof. Williams' many attacks upon them. Replying to one of these directed at an article describing the successful application of the methods used by the Commission, Engineering News-Record, March, 17, 1921, the writer said in part: "We hold no brief for either the surface area or water-cement theories. There are data which cannot be explained by either and which are apparently in direct contradiction thereto but there are also data which support them and which cannot be ignored. We have never claimed them as general in their application but, used as we have used them, they form valuable tools by which proportions can be more accurately set than by any scheme of equal simplicity yet developed. We fully expect them to be superseded at some future time when our knowledge of concrete has broadened but until such time arrives and a better tool is found, they should not be utterly condemned."

We have not altered our views since that time although we have had the theories in question under examination in the laboratory and have used them in proportioning some 400,000 cu yds. of concrete on the Queenston-Chippawa development

The writer's experience with the flow table has not led him to the conclusion that it has "fully demonstrated its ability to accurately measure the consistency of concretes varying widely in cement content and aggregate gradations." The apparatus has been used for about two years in the laboratories of the Hydro-electric Power Commission of Ontario and the experience there has been that while it is an improvement over other tests for consistency which have been tried, it still leaves much to be desired. It has many of the faults of the slump test but to a less degree and the range of mixes and gradations over which it can be used is greater. It is hardly right to say that it has been standardized, as work with this purpose in view is, we understand, now in progress in the Bureau of Standards, where the flow table was first developed.

Yours truly,
R. B. Young,
Senr. Asst. Laboratory Engineer,
Hydro-electric Power Commission of Ontario.

Safety Code for Protection of Industrial Workers

A safety code for the protection of head and eyes of industrial workers has been recognized by the American Engineering Standards Committee, as "American Standard" and should contribute very materially to the reduction of accidents of that sort. Statistics show that of the blind population of the United States, 15 per cent have been rendered sightless by industrial accidents. Because of this serious situation the U. S. Bureau of Standards, with the cooperation of the War and Navy Departments, began in 1918 the preparations of a head and eye safety code. Several years ago this code was submitted for the approval of the American Engineering Standard Committee and it has since then been the subject of investigation, criticism and revision by a sectional committee made up of representatives of industry, insurance companies, employees, the manufacturers of protective equipment, safety societies and several state and federal government departments. The existance of this code makes it possible for the various state industrial commissions and municipal factory departments to put into force a set of regulations which represents the consensus of opinion as to the best method of preventing industrial eye accidents.

The subjects covered in the Head and Eye Safety Code are: Protectors for chippers, riveters, caulkers, etc.; protectors for scaling, grinding, etc.; protectors for exposure to dust and winds, etc.; protectors for babbitting, etc.; protectors for handling corrosive chemicals, dipping, brush coatings, etc.; protectors for sandblasting; protectors for exposure to glare; protectors for oxy-acetylene welding, furnace work, etc.; protectors for electric arc welding and cutting; operating rules; tests for frame and glass.

P. Lyall Co. Reports Big Contracts on Hand

The P. Lyall & Sons Construction Company is in a favorable position so far as future work is concerned. T. O. Lyall, vice-president and treasurer, is authority for the statement that the volume of work on the contracts on hand will keep the firm busy for four years. He referred chiefly to two tasks, the largest by far being that of the Welland Canal. which covers three miles, and will aggregate about $17,000,000. Then there is the graving dock at Esquimalt, B. C., which it was referred at one time would be cancelled, but it has been decided by the Government to continue. The volume of this will be close to $4,000,000, and will not be concluded for a couple of years. In addition new work to supplement this is expected for next year. The company is still negotiating for the payment of a commission on more than $3,000,000 of work on the Parliament Buildings at Ottawa in addition to the $5,000,000 on which they were paid.

Construction Developments During the Month of November

Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded and Contemplated

Construction Contracts Awarded in Eastern Canada, November, 1922

	Ontario		Quebec		New Brunswick		Nova Scotia		Eastern Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	2	$ 100,000	3	$ 210,000	....	$	....	$	5	$ 310,000
Churches	8	243,000	5	50,000	....	....	1	6,000	14	299,000
Factories	13	533,100	5	186,700	....	....	....	....	18	719,800
Public Garages	9	113,500	34	195,300	....	....	....	....	43	308,800
Hospitals	5	105,400	2	106,000	....	....	....	....	7	211,400
Hotels and Clubs	7	90,600	2	28,000	2	26,000	1	3,000	12	147,600
Office Buildings	5	185,000	4	183,000	....	....	....	....	9	368,000
Public Buildings	6	306,500	1	175,000	....	....	....	....	7	481,500
Residences	937	4,535,300	369	2,249,700	9	35,500	10	49,500	1328	6,889,000
Schools	11	1,086,500	7	1,150,000	1	30,000	....	....	19	2,266,500
Stores	50	482,500	11	1,652,000	2	9,000	1	3,000	64	2,146,500
Theatres	3	110,000	....	....	....	....	....	....	3	140,000
Warehouses	11	276,200	2	55,000	....	....	1	10,000	14	341,200
Total Buildings	1067	$8,197,600	445	$6,240,700	14	$ 100,500	14	$ 71,500	1543	$14,629,300
Bridges	....	....	2	10,000	....	....	....	....	2	10,000
Dams and Wharves	2	31,200	2	37,100	....	....	....	....	4	68,600
Sewers & Watermains	11	121,900	5	462,000	1	7,500	....	....	17	594,400
Roads and Streets	14	326,800	11	342,000	....	....	....	....	25	668,800
General Engineering	20	4,025,800	1	15,000	2	25,000	....	....	23	4,065,800
Grand Total	1114	$12,706,300	466	$7,107,100	17	$ 133,000	14	$ 71,500	1614	$20,036,900

Construction Contracts Awarded in Western Canada, November, 1922

	British Columbia		Alberta		Saskatchewan		Manitoba		Western Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	2	$ 54,500	....	$	....	$	....	$	2	$ 54,500
Churches	2	9,300	....	....	....	....	1	4,000	3	13,300
Factories	3	23,800	....	....	....	....	....	....	3	23,800
Public Garages	5	36,000	1	15,000	1	2,000	2	6,000	9	59,000
Hospitals	.	....	1	85,000	....	....	1	15,000	2	100,000
Hotels and Clubs	2	15,500	....	....	....	....	1	2,200	3	17,700
Office Buildings	1	8,500	....	....	....	....	....	....	1	8,500
Public Buildings	2	20,500	....	....	....	....	....	....	2	20,500
Residences	70	290,500	16	39,500	32	113,400	49	167,900	167	611,300
Schools	3	31,800	5	11,300	4	12,800	1	31,000	13	86,900
Stores	3	11,500	....	....	1	7,500	2	6,500	6	25,500
Warehouses	1	5,000	....	....	1	3,800	2	15,000	4	23,800
Total Buildings	94	$ 506,900	23	$ 150,800	39	$ 139,500	59	$ 247,600	215	$1,044,800
Bridges	3	20,500	....	....	....	....	....	....	3	20,500
Dams and Wharves	1	3,700	....	....	....	....	....	....	1	3,700
Sewers & Watermains	1	23,200	....	....	....	....	....	....	1	23,200
Roads and Streets	2	81,000	....	....	1	7,800	....	....	3	88,800
General Engineering	8	236,000	....	....	....	....	....	....	3	236,000
Grand Total	104	$ 871,300	23	$ 150,800	40	$ 147,300	59	$ 247,600	226	$1,417,000

Contemplated New Construction Work in Canada, November, 1922

	Ontario		Quebec		Maritime		Western		Dominion	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	3	$ 95,000	6	$ 290,000	....	$	2	$ 20,000	11	$ 405,000
Churches	6	285,000	1	85,000	1	10,000	2	10,500	10	390,500
Factories	16	675,000	2	160,000	2	95,000	3	200,000	23	1,130,000
Public Garages	4	40,000	1	40,000	....	....	1	4,000	6	84,000
Hospitals	1	30,000		....	1	45,000	1	15,000	3	90,000
Hotels and Clubs	5	88,000	1	35,000	1	10,000	2	95,000	9	228,000
Office Buildings	5	425,000	2	14,000	....	....	3	36,000	10	475,000
Public Buildings	15	251,500	2	100,000	1	5,000	3	44,500	21	401,000
Residences	265	1,630,600	324	2,193,500	6	24,500	3	12,000	598	3,860,600
Schools	9	517,000	9	531,000	....	....	8	121,000	26	1,169,000
Stores	17	1,027,500	3	60,000	1	5,000	2	15,000	23	1,107,500
Theatres	4	140,000	1	75,000	....	....	1	20,000	6	235,000
Warehouses	5	295,000	....	....	....	....	1	50,000	6	345,000
Total Buildings	355	$5,199,600	352	$3,583,500	13	$ 194,500	32	$ 643,000	752	$9,920,600
Bridges	....	....	3	95,000	....	....	....	....	3	95,000
Dams and Wharves	3	33,500	2	20,000	....	....	....	....	5	53,500
Sewers & Watermains	18	385,000	2	26,000	2	10,000	3	213,000	25	634,000
Roads and Streets	13	183,500	21	10,095,000	1	2,000	1	5,000	36	10,285,500
General Engineering	9	1,203,500	2	2,200,000	2	510,000	....	....	13	3,913,500
Grand Total	398	$7,305,100	382	$16,019,500	18	$ 716,500	36	$ 861,000	834	$24,902,100

The Proper Treatment of Posts for Guard Rails

How Guard Rail Posts May be Protected Against Decay —The Causes of Deterioration and Methods that are Recommended to Preserve the Wood

By **EDWARD F. PADDOCK**

Paper presented before the New Jersey Highway Association

Guard rail posts are exposed to particularly severe conditions and are subject to a number of dangerous and very contagious diseases known collectively and indiscriminately as rot or decay. Rot in timber is caused by the presence of fungi, or as they are commonly called toadstools or mushrooms. These are plants of a low order that grow not on but in the wood. Like other plants, they grow from seed, but from seed so small as to be invisible to the naked eye, except in masses. These seeds or spores are in the air at all times and are washed down by the rain or dew, so that the moisture that comes in contact with posts is full of them.

When one of these spores is deposited on a piece of wood, under suitable conditions it germinates and begins to grow in the wood, sending out a network of threads which find their food in the substance of the wood, just as a plant takes nourishment from the soil. To all outward appearances the wood is unchanged, but beneath the surface the fungus is taking away certain constituents of the wood and leaving it a mass of soft material that we know as rotten wood.

When the fungus reaches maturity its next business is the reproduction of its kind and it is only then that we become aware of its presence. It begins to bear fruit. This fruit appears on the surface of the wood in the form of toadstools, mushrooms, punks or conks, which soon begin scattering seeds by the million and the process begins again.

Four Essentials of Decay

Like all other plants, fungi require moisture, air a suitable temperature and food. Remove any one of these essentials and the fungus cannot develop. In the case of guard-rail posts, however, these conditions are not within our control. The post is set in the ground where it is almost continually damp and where the moisture in the wood has little chance to evaporate. It is exposed to the air above and often for some distance below the ground line. Our climate furnishes temperatures that are suitable for fungus growth. There remains only the food supply and this being the post itself, cannot be removed. The only thing left for us to do is to prevent fungus from coming in contact with the wood, or to so poison the wood that fungus spores coming in contact with it will not germinate. This is the business of the wood preservative, to form an unbroken antiseptic zone above the wood or at least such a portion of it as is unprotected and would provide suitable soil for the development of fungi.

The simplest form of wood preservative is paint. If the wood is free from fungus and fungus spores, which it rarely is, a coat of paint will keep new spores from reaching the wood and so prevent rot just as long as the coating of paint remains whole and unbroken, but no longer. As soon as the paint film is scratched through or broken in any way, fungus spores can reach the wood and do reach it as we all know, for painted wood does rot, and when decay has once started all the painting we can do will not help it.

Tarring not a Cure-All

Only a little better than painting is the coating of the wood with hot tar. The only advantages that this has over painting are that the heat of the tar when applied may kill any fungus or fungus spores that lie at or near the surface of the wood and being applied hot, a little of the tar will penetrate the outer cells of the wood and so make it a little more difficult to break through the protective coating. When the tar cools, however, it is easily cracked or injured and then decay can start.

Another method of preventing decay has been repeatedly tried and it appeals on account of its simplicity. I refer to charring. It was thought that by subjecting the outer portion of the wood to fire, not only the fungus in it would be killed but that the outer portions of the wood would be partially distilled, leaving preservative materials in the wood. This sounds very plausible but experience has repeatedly shown that not only will charred wood decay very readily, but further, that the substances distilled from wood and known as wood tar and wood tar creosote have very little preservative value even when used in far greater quantities than are produced in charring the wood.

It appears then, that in order to prevent decay we must in some way poison the outer portions of the wood so that fungi will not grow in it and so that this protection antiseptic zone may not easily be broken. This means that the preservative must enter the wood deep enough so that ordinary wear will not break through and expose untreated wood. It means further that this preservative material must be of a permanent nature so that it will remain in the wood after it is put there.

Probably the cheapest and simplest preservatives are metallic salt solutions, such as copper sulphate, mercuric chloride, zinc chloride and sodium fluoride. These are all soluble in water and are applied in water solution. They are injected into the wood under pressure or absorbed by immersion in baths of the preservative. After the treatment the water evaporates, leaving the preservative salts in the wood.

This is all very well for wood that is to be used in comparatively dry situations, but where the wood is to be embedded in the ground and will be in contact with earth that is damp for the greater part of the time, they have not proven successful. Under such conditions the process known as leaching takes place, whereby the salts are gradually dissolved in the moisture of the surrounding soil and carried away from the wood so that in a comparatively short time the preservative disappears from the wood leaving it unprotected.

The Effectiveness of Coal Tar Distillates

There is, however, a class of preservatives that are only very slightly soluble in water and which at the same time are extremely poisonous to fungi. These are the heavy oils distilled from coal tar and known as dead oil or creosote and green or anthracene oil. Many years of experiment and actual experience have demonstrated the efficacy of these coal tar distillates so that to-day they are recognized as the very best means of prolonging the life of the wood under all sorts of conditions of exposure.

Now just what are the conditions that a guard-rail post must meet, as far as decay is concerned? First, it is set in the ground so that the lower three feet of it are surrounded by earth. As we know, earth, even in well drained sand, never dries out more than a few inches below the surface, so that the post below the ground line is kept continually moist. The exposed upper part of the post has plenty of air but remains dry. The earth in which the butt of the post is embedded is sufficiently porous to provide an air supply to the post for some distance below the ground line. In clay, this may be only an inch or two, while sand or gravel may be sufficiently porous to allow air to reach the very bottom of the post. Where the posts are shaded by grass and weeds, they frequently remain damp for several inches above the ground line. We see then that just above and below the ground line there is a zone where fungi have just the conditions necessary for their development and that this zone may extend slightly above the ground line and may include the entire lower end of the post.

The Coal Tar Preservatives

The coal tar preservatives of which I have spoken consist of a very complex mixture of chemical compounds. Some of these compounds evaporate readily and consequently do not remain long in the wood, while others are of such high boiling points that they will practically not evaporate at all at ordinary temperatures, or even at the temperatures used during treatment. Here then is the difference between creosote and anthracene oil. Creosote contains a larger proportion of volatile constituents while anthracene oil consists almost entirely of nonvolatile oils that remain permanently in the wood. It would seem then that when creosote is used as a preservative we must anticipate that a larger portion of it will disappear when it is exposed to the air. Experiment has proven this to be true and also that the portion that does remain permanently to preserve the wood, consists of the high boiling nonvolatile oils, the anthracene oils.

In the preservation of railroad ties, about a gallon of creosote per cubic foot or, roughly, a pound and a half per square foot of lateral surface is found to be necessary to insure proper protection. This is forced into the wood by means of pumps in a tight cylinder. Obviously the entire surface of the wood is treated. In the case of guard-rail posts this is out of the question, because for several reasons the surface of the post above the ground must not be oily. If it were, it would be impossible to paint it white, for the creosote would quickly destroy the color. If it were oily, it would soil the clothing of anyone coming in contact with it. Since it is exposed to the air it is for the most part dry and will not readily rot, so that one-half of the treatment would be wasted.

Methods of Treatment

Our treatment then must be confined to such portions of the post as are exposed to decay. Two methods of application present themselves, brushing and immersion in an iron tank of the preservative. Obviously, it is impossible to put a pound and a half of creosote or anything approaching this quantity in every square foot of surface with a brush. With open tanks it is possible but only by means of treatments lasting so long as to make them impracticable. Where any appreciable amount of posts are to be treated this means days or weeks of labor or large tank capacity both for treatment and storage of preservative.

This brings us to the anthracene oils which on account of their nonvolatile nature remain permanently in the wood and which consequently can be used in much smaller quantities to obtain the same results. The higher the specific gravities and boiling points of these oils, the more permanent they are and the less is required for preservation.

Comparable tests of anthracene oils, creosote and other preservatives have invariably shown the superiority of the high boiling permanent oils.

For guard-rail posts I would unquestionably recommend what is known as the "hot and cold" double immersion treatment. The apparatus necessary consists of two tanks about 3 ft. in diameter and 4 ft. 6 in. deep. The bottoms of these tanks should be protected from injury by laying piece of "I" beam or rail in the bottom. One of these tanks should be provided with steam coils or be so mounted that a fire may be built beneath it., The other, which is for the cold bath, should be provided with a draining platform on which the treated posts may be stood to allow the surface oil to run off and be returned to the tank. Such tanks as these are readily portable and may even be mounted on a steel truck so that the treating may be done either at the storage yard or on the job.

The process consists in filling the tanks to such a depth, that while the posts are being treated they will be covered to a depth of 3 ft. 8 in. The oil in the first tank is heated to about 180 deg. fahr., and held at this temperature throughout the treatment. The posts should be kept submerged in this bath for twenty minutes, then removed and immediately placed in the second tank containing the cold preservative. They should remain in this tank for ten minutes and finally removed to the draining table where they will in a few minutes become dry enough to handle.

The equipment that I have described is capable of treating ten posts at a time and allowing five minutes for each charge to remove the treated posts and replace them with untreated posts, will treat 180 posts in 8 hrs.

So far, I have spoken only of that portion of the post from the ground line down. There are, however, portions of the exposed post where decay is likely to occur. Posts have their tops sawed at an angle and the top rail is fastened so that it rests on this sloping top. Whenever it rains moisture collects in the space between the top rail and the top of the post and is absorbed by the post. This surface being protected by the rail dries out very slowly and consequently the tops of the posts frequently decay. The same is true of the contact surface where lower rails are nailed to the side of the post or within the holes through which cable is passed. Such contact surfaces and joints should receive protection. Personally I would sacrifice appearance and at least brush-treat all surfaces. Another way would be to give the entire exposed portion of the post an open tank treatment just as the bottom was treated, using instead of the oil, a solution of sodium fluoride.

Sewage Treatment at Manchester, Eng.

A Report of the Operations of the Plants of a City that Has Been Well in Advance in Sewage Treatment Matters—Important Research Work and Experiments

The sewage treatment experiences of Manchester, Eng., have always been followed with keen interest by municipal officials in all parts of the world, for that city has always been in the forefront in all investigations relating to sewage matters. For that reason the following extracts from the report of the Manchester River Department covering the twelve months ended March 31 last will be of value to those concerned with the problem of sewage disposal.

The Withington Works

These works were originally designed to purify the sewage by treatment on the land. Subsequently a sedimentation tank and double-contact filter plant was installed as follows: Two detritus tanks (capacity 83,400 gallons), two sedimentation tanks (capacity 781,000 gallons), ten first contacts beds (2,000 superficial yds. each), ten second contacts beds (2,900 superficial yds. each), and an area of storm beds of 12,452 superficial yds. divided into four plots measuring respectively 2,882, 3,533, 3,751, and 2,286 superficial yds. A conical catch-pit in connection with the high-level sewer was constructed later. In 1914 two Emscher (double-decked) tanks were constructed, of sufficient capacity to deal with from 600,000 to 700,000 gallons per day.

A continuous-flow for the treatment of the sewage by the activated sludge process was brought into operation in October 1917, and occupies one-third of one of the above-mentioned sedimentation tanks.

The average daily flow of sewage (including storm water) for the year under observation amounted to 3,028,000 gallons, or 46 gallons per head of population per day. During the phenomenal drought experienced in June and July, 1921, the daily flow fell below 2,000,000 gallons, which is the lowest flow recorded at these works.

As stated in the last report, immediately prior to the commencement of the period covered by this report, the destructor, which had hitherto been the source of power, was dismantled, and, with the exception of the suction gas plant referred to above, the whole of the power used on the works is now derived from the corporation electrical supply.

The plant in the engine room comprises four centrifugal pumps for lifting the low-level sewage, air compressor for delivering the sludge through mains on to the land, and air compressor for the operation of the activated sludge installation, all driven from electric motors of from 15-h.p. to 60-h.p. In addition there are small motors attached to screens placed on high and low level sewers, and for driving chopping machine.

Volume of Sewage Treated

The volume of sewage actually delivered at these works is estimated at 1,102,293,000 gallons, an average of 3,028,000 gallons per day.

Sludge Disposal

In the following table is given the amount of sludge removed during the year from the various tanks:—

	Tons
Screenings, etc.	800
Conical Tank	1,000
Detritus Tanks, Sedimentation Tanks and Activated-sludge Tank	18,193
Emscher Tanks	1,060
Total	21,053

The total amount of sludge produced—viz., 21,053 tons—is equal to 19.1 tons per million gallons.

The sludge from the detritus and sedimentation tanks and the bulk of that produced by the activated sludge process has been trenched into the land as usual.

In addition to the above, 840 tons of detritus material have been removed from the storm-water reservoir.

Emscher Tanks

These tanks have been in continuous operation throughout the year, and have dealt with 212,936,000 gallons of sewage, an average of 585,000 gallons per day, as compared with a daily flow of 654,000 gallons during the preceding year.

Approximately 300 tons of refuse, &c., were removed from the screens and catch-pits preceding the tanks. A total of 1,060 tons of sludge were discharged from these tanks on to the drainage beds provided. The air-dried sludge has been used on the land under cultivation.

No trouble has been experienced with respect to the ebullition of the scum of the aerial nuisance.

Apart from the volume of sewage treated in the activated sludge plant—viz., 93,157,000 gallons—the whole flow of sewage received at the works was treated on the filtration areas. The storm beds dealt with a total volume of 169,574,000 gallons, which is equal to 186,000 gallons per acre per day. The primary secondary beds dealt with a total volume of 839,562,000 gallons, which means that on the average (including all periods of rest) tank effluent was applied to the primary beds at the rate of 384,000 gallons per acre per day.

Owing to the cessation of renewal operations over a period of years the effective capacity of the primary and secondary beds has been appreciably lowered. To regain and maintain the original capacity of the filtration plant would consequently mean not only very extensive immediate renewal work, but appreciable annual expenditure in the future. In the light of the experience gained with the existing activated sludge plant it was felt advantageous to increase the proportion of the flow of sewage received at these works treated by this process rather than incur serious expense on the renewal of the filters. The consent of the city council has been obtained for the utilization of funds accumulated for such renewal work for the purpose of constructing an additional activated sludge continuous-flow unit capable of dealing with 1,000,000 gallons of the dry-weather flow per day and storm water up to the rate of three times this volume. By this means it is anticipated that a better average effluent will be obtained, and at the same time economy will be effected in future running cost. In design the proposed new plant is similar to the installation at Davyhulme, so that the performance of this plant will enable a strict comparison to be made between the relative merits of this design and that of the original plant at these works.

Treatment by the Activated Sludge Process

The continuous-flow unit installed at these works in October, 1917, for the treatment of a portion of the sewage by the activated sludge process is described, with plan, in the annual report for the year ending March, 1918. The unit consists essentially of an aeration tank 6 ft. deep, of capacity 55,000 gallons wherein the mixture of sewage to be purified and activated sludge is aerated and agitated on the "diffused aeration" system, and a settlement tank, capacity 27,000 gallons, in which the activated sludge and effluent are finally separated.

From April 13, 1921, to the year ending March 29, 1922, 92,372,000 gallons of sewage which had been screened and passed through detritus tanks whose capacity is equal to approximately forty minutes' dry-weather flow were dealt with by the plant at an average rate of 280,000 gallons per day when in actual operation, or at 263,000 gallons per day inclusive of all periods of stoppage.

During the period under review the volume of air used has been in excess of that employed in previous years, partly on account of the stronger sewage treated and partly for the purposes of experiment. The use of the additional volume of air is compensated for very largely, however, by the slightly increased volume of sewage treated per day, notwithstanding the fact that the sewage dealt with has been substantially stronger than formerly.

The diffusers, which have now been in use for a period of five years, continue to give satisfaction, a slight increase only in friction being observed.

The Davyhulme Works

The volume of sewage delivered at the Davyhulme works from March 31, 1921, to March 29, 1922 (inclusive), including 13,447,000 gallons from the parish of Davyhulme, was 17,083,598,000 gallons.

The average daily flow of sewage was 46,933,000 gallons, showing a decrease on the previous year of 4,397,000 gallons, or 8.6 per cent.

The average daily flow of sewage per head of population has ranged from a minimum of 54 gallons for the four weeks ending July 20, 1921, to a maximum of 76 gallons for the four weeks ending March 1, 1922.

The total volume of sewage dealt with by the various filter beds (primary contact and storm water filters) during the year amounted to 10,069,719,000 gallons, or 59 per cent of the total flow of sewage.

Of the total quantity thus filtered, 5,176,992,000 gallons were treated on the secondary filter beds. This volume is equal to 59 per cent of the primary effluent, or 30 per cent, of the total sewage flow.

Practically the whole of the unfiltered sewage received treatment in sedimentation tanks prior to its discharge to the canal.

The total filtration cost for labor and sundry expenses amounted to £39,238 16s. 9d., or £3 17s. 11.3d. per million gallons actually filtered, as against £4 3s. 10.5d. for the previous year.

The total sludge production during the year was 217,125 tons, which is equal to 12.7 tons per million gallons sewage treated.

Of this amount 203,206 tons were sent out to sea, 1,260 tons dealt with by the sludge presses and mainly subsequently dried and sold as a fertiliser, and 12,659 tons of water or thin sludge were decanted from the sludge storage tanks (prior to loading the steamer), and discharged on to drainage beds.

A double shell rotary cylindrical dryer has been installed with the object of increasing the output of dried sludge. The capacity of this machine, which is heated from the existing destructor (portion), is 15 cwt. per hour, of a product containing 15 per cent moisture when dealing with pressed cake containing not more than 60 per cent water.

Unfortunately, owing mainly to agricultural depression, the demand for fertilisers of this type has fallen so considerably as to be considered almost negligible, with the consequence that, during the year reported upon, only 180 tons of dried sludge have been sold. In these circumstances, of course, appreciable loss has been sustained in this section of sludge disposal. With the resumption of the normal demand for this product it will be possible, by the use of the above-mentioned machine, to produce this material at a lower cost than previously.

Summary of Results

The following summary of the results obtained at the Davyhulme Works is submitted:—

Total flow of sewage:—
Main outfall 17,070,151,000 gallons }
Point "E" 13,447,000 gallons } =17,083,598,000 gallons
Total sludge removed =217,125 tons
=12.7 tons per million gallons
Cost of sludge disposal =£33,670 2s. 10d.
=£1 19s. 5d. per million gals.
Total volume of sewage filtered (primary contact beds and storm beds) =10,069,719,000 gallons
=59% of the total sewage flow
Total volume filtered by secondary beds =5,176,992,000 gallons
=59% of the primary effluent
=30% of the total sewage flow
Cost of filtration =Total, £39,238 16s. 9d.
Maintenance, £11,627 12s. 7d.
Renewals, £27,611 4s. 2d.

	=Total.			Maintenance.			Renewals.		
	£	s.	d.	£	s.	d.	£	s.	d.
Per million gallons, sewage flow	2	5	11.2	0	13	7.3	1	12	3.9
Per million gallons, filtered	3	17	11.3	1	3	1.2	2	14	10.1

Total Revenue Cost (apart from interest charge, and repayment of debt, but inclusive of sundry special non-recurring items:—

	Per million gallons		
	£	s.	d.
Sludge disposal	1	19	5.0
Filtration	2	5	11.2
General expenses	1	8	6.6
Total	£5	13	10.8

Average Cost per Head of Population

For year ending 29th March, 1922 .... =31.5d.
For 17 years ending 22th March, 1922 .. =13.1d.

Research Work

During the year the research relating to the dewatering or activated sludge has been extended, chiefly with reference to vacuum treatment. The work has included also further experiments with the small sludge press referred to in the last report, a trial with a centrifuge of special design which proved to be unsuitable for the purpose, experiments with certain appliances, and a large number of laboratory experiments having a bearing on the dewatering problem.

Filter Pressing

In continuing the experiments previously reported upon special attention has been paid to the effect of the addition of mineral matter to the acidified sludge prior to pressing. The addition of light material, such as flue dust, materially assists the release of water from the sludge with the production of a cake of a reduced water content—e.g., the addition of one part of fine dust to five parts of activated sludge (in terms of dry matter) effects a reduction of from 4 to 5 per cent in the water content of the resultant cake (six hours press). The sludge obtained at the Withington works is originally so rich in organic matter (80 per cent of dry matter) that the final product remains rich in nitrogen, while the availablity of the plant food constituents remains unimpaired.

The quantity of inert mineral matter required to produce a press cake of from 65-70 per cent water content in six hours is, however, so large as seriously to depreciate the value of the final product.

Further work on these lines is contemplated with the use of various other waste mineral matters.

Vacuum Treatment

Extended trials have been made at the College of Technology with a paper-making machine, modified by the addition of several more vacuum boxes. The result of these trials may be summarized briefly as follows:—

1. They confirmed the results of the earlier laboratory experiments at Davyhulme.
2. That preliminary treatment of the sludge with acid prior to exposure to vacuum facilitates the removal of water, and that the cost of such treatment is more than counterbalanced by the increased output.
3. That by simple drainage and vacuum treatment of acidified activated sludge (Davyhulme works) the water content may be reduced to from 84 to 86 per cent, which means a reduction in actual volume of the sludge of from 6 to 1.
4. That, so far as these trials have been carried, preliminary heating of the sludge does not appear practicable, having regard to the resultant effect.
5. That the process is a practicable one in so far as the cost of power—for vacuum and operation of machine—and of labor required is concerned, but that the available information with respect to the probable renewal cost is such as to render the total treatment costly, if not prohibitive; moreover, the capital charges in relation to output are by no means negligible. In view of the high renewal costs when operating the vacuum process on the horizontal travelling gauge system, the vacuum wheel method of would appear to offer advantage. Our experience suggests that it is economical to make provision for an adequate settlement (film) prior to application of vacuum, and that apparently better results are obtained when working with thin films at a comparatively high rate than with thicker films at a lower rate.

Removal of Extraneous Water

During the investigation carried out at the College of Technology it was found possible to obtain a considerable release of water from the sludge without the use of vacuum by treatment in either (a) a slowly rotating wire-mesh cone fed internally, or (b) by revolving a gauze cylinder in the sludge itself. By these similar means a product was readily obtained without the addition of acid, containing not more than (average) 94 per cent water, which means a reduction in volume of the original sludge of from 3 to 1.

On passing this product over an endless wire gauze carried on rollers, over which travelled a super-imposed gauze or impervious band in such a manner as to have a pronounced squeezing effect, the water content was further reduced to 86 per cent.

The possibility of utilizing the property of activated sludge of rising to the surface when impregnated with gases has not been overlooked. A number of laboratory experiments have been made on these lines. In the light of information gained in other directions, however, and in view of the somewhat uncertain character of sludge flotation, this method would not appear to offer very good prospects of success.

Summarizing the experience so far gained in connection with the problem of the economic dewatering of activated sludge, it would appear the sludge may be densified very considerably—i.e., from 98 per cent water to 94 per cent water, or a reduction of two-thirds by volume, by simple and inexpensive means; but the further serious removal of water by purely mechanical methods (vacuum, centrifuge, or press) is likely to involve material expense both in capital outlay and running costs. It is therefore questionable whether the application of mechanical methods for the removal of water beyond the point indicated can be justified, having regard to the ease with which the densified sludge may be dried at low temperatures under suitable conditions.

Large Scale Continuous-Flow Activated Sludge Plant

As stated in the last report, this plant, which was fully described in the annual report for the year ended March, 1919, was brought into commission just prior to the period covered by this report.

The first quarter of the year was occupied in "building-up" the necessary supply of activated sludge and in studying the conditions required for the establishment of a thoroughly active sludge. During this period difficulty was experienced in establishing a vigorous growth of nitrifying organisms, due doubtless to the character of the trade waste entering the city sewers. Experience has shown that, when dealing with the mixed city sewage, it is almost impracticable to maintain a highly-nitrified effluent, and, consequently, during the subsequent operation of this plant, the performance of the plant was judged by taking mainly into consideration the following criteria in respect of the effluent produced:

1. Suspended matter content.
2. Clarification—i.e., removal of celloids.
3. Dissolved oxygen absorption—as compared by the Royal Commission on Sewage Disposal, and
4. Behaviour on incubation.

Including all periods, a purification of the screened and detritus free sewage of from 76 to 81 per cent was obtained (measured by the albuminoid and four hours' oxygen absorption tests), representing a purification of the crude sewage of from 80 to 84 per cent.

Periodic disturbances of the purification process have been observed at such times as abnormal amounts of oil (either edible or mixtures of edible and mineral oil), and more especially heavy tar oils were present in the sewage treated.

These products are liable to exert an emulsification effect (physical rather than bactericidal) with the production of a turbid or imperfectly clarified effluent. The somewhat high dissolved oxygen absorption figures and the number of putrefactive samples are attributable to this deleterious action.

The flow of sewage treated in this plant has varied from a minimum rate of 240,000 to a maximum of 2,000,000 gallons per twenty-four hours, the largest volume treated in any one day being 1,657,000 gallons.

In the following tables are given the total volumes of sewage treated during the last three-quarters of the year, together with the volume of air employed (in terms of cubic feet free air per gallon of sewage treated), inclusive of that required for the operation of the return sludge air-lifts.

Volume of Sewage Treated and Air Consumption

Quarter ending	Total volume of sewage treated	Average daily volume	Average volume of air used per minute	Average volume of air used per gallon of sewage
	Gallons	Gallons	Cu. ft.	Cu. ft.
Sept. 28th, 1921	45,788,000	538,000	650	1.73
Dec. 28th, 1921	63,310,000	696,000	715	1.48
March 29th, 1922	42,006,000	808,000	780	1.39
Average	151,104,000	663,000	715	1.55

During the last quarter the plant was out of commission for a period of five weeks, mainly for the purpose of further investigating the question of the establishment of a nitrifying sludge, and consequently the daily rate has been calculated on the period the plant was actually in operation.

Experience with the installation subsequent to the period covered by this report has shown that by using an additional supply the volume of sewage may be increased, with the result that at the present date the average daily flow treated amounts to approximately 1,000,000 gallons per day, with an air consumption of not more than 1.5 cub. ft. free air per gallon of sewage treated.

Assuming 50 per cent compressor efficiency, this volume of air would require approximately 35 b.h.p. per 1,000,000 gallons of sewage treated (average flow).

For the purpose of this demonstration, existing compressors of less over-all efficiency were compulsorily employed. It is anticipated this air plant will be eventually replaced by more suitable compressors where over-all efficiency should be certainly not less than 50 per cent, and probably considerably in excess of this figure, with consequent reduction on the b.h.p. figure previously quoted.

The utmost endeavor is being made to hasten to a successful conclusion the development of the activated sludge process of sewage purification. The experience gained with the demonstration plant reported upon has confirmed the view previously expressed with respect to the possibilities of this process. Its successful application to the treatment of the city sewage is still, however, dependent on a solution of the problem of preparing a portable product from the resultant sludge at a cost more or less commensurate with its intrinsic value as a fertilizer. From the point of view of the economic future extension of the purification plant the importance of the research work proceeding in connection with this problem cannot be over-estimated.

The Cost of Supplies for City of Toronto

The works department and other civic departments of the city of Toronto, Ont., have recently made contracts for the supplies required during the year 1923. Tenders for these were asked and in most cases contracts were entered into with the low bidders, although in some cases where the prices were not considered satisfactory, the department officials were authorized to buy in the open market.

Refined asphalt was quoted at prices varying from $20.45 to $25.43 per net ton, f.o.b. tank cars, at Toronto, or from $24.74 to $36.04 f.o.b. cars in metal containers. The low tender in each case was accepted.

Crushed stone was quoted at $1.88, $2.00 and $2.10 per net ton, f.o.b. cars at Toronto, for the 2", 1" and ¾" sizes respectively. These figures include the sales tax. Crushed trap rock was contracted for at the followng prices per net ton, f.o.b. the quarry: 2", $1.30⅝, 1", $2.09 and ⅜", $2.61¼. Present freight rates on this material are 90 cents per ton and under the terms of the contract the city is to be given the advantage of any decrease in freight rates.

Sewer brick and vitrified paving blocks and granite setts will be purchased in the open market as the prices quoted by the tenderers are higher than the present market quotations. The prices quoted were as follows: Sewer brick, $19.45 per thousand f.o.b. cars and $26.45 delivered for arch brick, and $17.45 f.o.b. cars and $24.45 delivered for rectangular brick. No. 1 lug vitrified paving blocks were quoted at $52.75 per thousand for the 3" sizes and $60.95 for the 4" sizes. These prices applied f.o.b. cars at Toronto. On granite setts, two tenders were received—one quoted $113.00 per thousand f.o.b. cars with sales tax extra and the other $115.00, including the sales tax.

Sewer pipe was contracted at the following prices: 4" 16½c; 6", 24½c; 9", 41c; 12", 61½c 15", 96½c; 18",, $1.29; 20", $1.60; 21", $1.72; 23", $2.07; 24" $2.57½. Quotations were also received on specials of all varieties.

Water works supplies are being obtained at the following prices:

Liquid chlorine; $1.43 per ton in car load lots or $1.49 per ton in cylinders, furnished by the contractors. Hydrants: three-way hydrants complete, $76.85; additional frost jackets, $9.23; additional three-way feed pipe, $11.45.

Cast iron pipe, per length—3", $7.60, 4", $9.60, 6". $16.00, 8", $21.60, 10", $30.40, 12", $41.20.

Stop valves—3", 023.10, 4", $26.40, 6", $27.39, 8", $55.00, 12". $64.27.

Brass and bronze castings: phospher bronze, 25c per lb.; Imperial phosphor, 30c per lb.; Tobin bronze, 21c per lb. and brass castings, 22c per lb.

Lead pipe, $10.50 per 100 lbs for sizes from ⅝" to 1".

In connection with these contracts the following clause is included:

"Prices quoted........shall be the maximum price as herein specified that will be charged during the currency of the contract. The successful tenderer agrees to give to the city of Toronto any advantage of a decrease in price of the material specified in this contract as indicated from time to time by the current market price of the material in Toronto at the time of delivery."

American Good Roads Congress

Official Program of the Meeting on January 16-19 Includes a Wide Variety of Papers

The official program of the thirteenth American Good Roads Congress to be held under the auspices of the American Road Builders' Association at the Congress Hotel, Chicago, Ill., on January 16, 17, 18 19, 1923, has just been issued. It indicates a wide range of topics to be discussed, some of the important papers being as follows:

Continued Highway Expenditures Required to Meet Demands of The Future, by Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, Washington, D. C.

Progressive Construction of Highways: (a) Practice in North Carolina, by C. M. Upham, state highway engineer, North Carolina; (b) Practice in Iowa, by C. Coykendall, assistant chief engineer, Iowa Highway Commission.

The Obligation of the State Highway Department to Keep the Public "Sold" on Highways, by H. E. Hilts, acting chief engineer, Pennsylvania State Highway Department, Harrisburg, Pa.

What Test Roads Have Taught Us: (a) Bates test road, by Clifford Older, state highway engineer of Illinois, Springfield, Ill.; (b) Pittsburgh test road, by Lloyd Aldrich, consulting engineer, San Francisco, California; (c) Arlington tests, by A. T. Goldbeck, engineer of tests, Bureau of Public Roads Washington, D. C.

Development of apparatus for Field Testing of Roads, by H. F. Clemmer, testing engineer, Division of Highways, Springfield, Ill.

Development in the Use of Local Materials, by Vernon M. Pierce, district engineer, U. S. Bureau of Public Roads, Washington, D. C.

Designed Subgrade, by C. M. Upham, state highway engineer, Raleigh, N. C.

Haulage Methods in Highway Construction: industrial Railways, by A. J. Parrish, general contractor, Paris, Ill.; Heavy Truck Haulage, by Charles H. Fry, Charles H. Fry Construction Co., Erie, Penna.; Light Truck Haulage, by A. E. Horst, Henry W. Horst Co., Rock Island, Ill.

How to Equip and Operate Local Gravel Pit to Produce Concrete Aggregate, by H. E. Kuelling, construction engineer, Wisconsin Highway Commission, Madison, Wis.

How Much Time is Lost in Delays in Highway Building? by H. K. Davis, chief inspector, Iowa Highway Commission, Ames, Iowa; discussion, by B. H. Piepmeier, state highway engineer of Missouri, Jefferson City.

What Roadbuilding Work Can be Done in Winter? by John H. Mullen, chief engineer, Minnesota Highway Department, St. Paul, Minn.

Organization of Intensive Maintenance on a State Highway System in Eighteen Months, by Frank Page, chairman, North Carolina State Highway Commission, Raleigh, N. C.

Four Years' Experience With Patrol Maintenance in Wisconsin, by J. T. Donaghey, maintenance engineer, Wisconsin Highway Commission, Madison, Wis.

Gravel Road Maintenance Practice in Michigan, by L. H. Nielsen, deputy state highway commissioner of Michigan, Lansing, Mich.

Blade Grader and Road Drag Earth-Road Maintenance in Iowa by W. H. Root, maintenance engineer, Iowa State Highway Commission, Ames, Iowa.

Salvaging and Maintenance Macadam Roads, by W. A. Van Duzer, assistant maintenance engineer, Pennsylvania Highway Commission, Harrisburg, Pa.; discussion, by A. W. Muir, superintendent of maintenance, New Jersey Highway Commission, Trenton, N. J.

Tourist Traffic as a Factor in Highway Development (Illustrated), by A. R. Hirst, state highway engineer of Wisconsin, Madison, Wis.

Changes Needed in Motor Vehicle Legislation and License Fees, by J. N. Mackall, Commissioner of Roads, Baltimore, Md.

Have Large Expenditures Changed the Public Attitude Toward Highway Development? by S. E. Bradt, former superintendent of highways of Illinois.

Co-operation Between State and County Department, by L. C. Herrick, director of highways and public works, Columbus, Ohio.

How Individual Organizations Can Fit Their Work Into the Broad Highway Research Program, by W. K. Hatt, director of highway research committee, National Research Council, Washington, D. C.

The A. C. B. C. I. Conference

We are in receipt of a letter from Mr. J. C. Reilly the executive secretary of the Association of Canadian Builders' and Construction Industries, referring to the fifth construction conference to be held at the Chateau Frontenac, Quebec City, on Feb. 6-9, 1923. Mr. Reilly writes that the Quebec Builders' Association are prepared to co-operate in every way possible to make the stay of the delegates pleasant and to insure the success of the conference.

There will be ample accommodation at the Chateau Frontenac for delegates and for the housing of members' exhibits. In addition there will be a splendid programme of winter sports on the Dufferin Terrace including curling rink, skating rink and toboggan slides. It is likely that the Quebec Association will join with the A.C.B.C.I. in having their annual banquet as the concluding feature of the conference.

Arrangements are being made at present for some excellent speakers, particulars of which will be announced later. There is every reason to expect that this Conference will be the best yet.

Koehring Co's. Montreal Office

The Koehring Company of Canada Limited have now opened their own office in Montreal, at 616 Canada Cement Company Building, Phillips Square, Montreal, Telephone Uptown 3026. Mr. A. W. Guyer, previously associated with some large contractors in construction work in Montreal and vicinity, and before that with the Eastern Equipment Company, will be in charge of the office. The Montreal office will take care of sales throughout the province of Quebec. The company will also carry in stock in Montreal a large number of machines and a stock of spare parts, so that they will be in a position to serve customers promptly.

The next convention of the American Concrete Institute will be held in Cincinnati, Ohio, at the Hotel Sinton, Monday, Tuesday, Wednesday and Thursday, January 22-25, 1923.

Ventilation Principles and Practice

The Importance of Ventilation and the Systems that Are Applicable to Various Types of Buildings—Standard Requirements—Relationship of Heating and Ventilation

From "The Builder"

Ventilation in the sense in which the word is generally accepted means the continuous and more or less regular changing or renewal of the air in an enclosed space. Ventilation is desired and provided in order to remove impurities or stagnation of the air, and to ensure continual freshness by replacing vitiated air with new air. The greater the use to which air is put the greater the need for adequate ventilation.

While ventilation may be required to remove an excess of water vapour arising from various causes, or to keep an uninhabited space free from dampness, or to remove foul or noxious odours produced either by natural or manufacturing processes, it is more generally employed to dilute and remove the exhalations of human beings and the products of combustion due to heating and illuminating apparatus, and to maintain the air condition, both as to quality and temperature, within the limits required for general comfort.

Ventilation involves the introduction of air as clean and pure as possible, with the necessary amount of moisture or humidity, its general diffusion throughout the space to be dealt with, and the removal of the contaminated air constantly and regularly. The great majority of human habitations in places subject to low temperatures hace no special provisions of ventilation during those periods when artificial heating is necessary. Even in the majority of large and costly public buildings, such as theatres, music halls, churches, municipal buildings, and the like, it is only comparatively recently that serious thought has been given to this subject. This has undoubtedly been due to the want of appreciation of the value in improvement and maintenance of general health and comfort to be secured by adequate ventilation. Greater regard is gradually being given to the vital subject, but much advancement has still to be made before we shall have reached the stage where ventilation is held in the esteem commensurate with its value to the community.

The Importance of Ventilation

If, in selecting a house, or in considering which school to send children to, inquiries were made as to the means of ventilation provided, those making such inquiries would but a short time ago—if not now—be numbered among the cranks and faddists. Even now it is safe to say that such a person would be considered too particular. The evil effects of the continuous inhalation of impure air are not such as in most cases to attract notice, unless the impurity be considerable or because the temperature and moisture be such as to produce discomfort at the time. The injury caused by breathing air deficient in oxygen or contaminated by organic exhalations and emanations is not, or may not be, perceptible for some considerable time, and even then may be attributed to other causes. Not only must we consider the harmfulness of impure air, but it must be borne in mind that such air forms a more suitable medium for the production or aggravation of illness and disease, especially of those complaints which are affections of the respiratory system.

Ventilation is just as necessary for cleanliness as it is as a disease preventative. We should be just as loath to breathe the air exhalations of others as we are to put into our mouths anything which has the merest suspicion of being unclean. In many cases it is difficult, if not impossible, to separate the effects of impure air from those of insufficient or improper feeding, but, if we consider the importance of respiration to life, the large surfaces which the air-passages and lungs present for the reception of micro-organisms, and the favorable conditions as to temperature and moisture for their development, we can readily see that the purity of air, and the constant removal of the excretions borne out with it, must have much to do with the health and vigour of the individual. All this may be more or less general knowledge, but it cannot be too often reiterated that adequate ventilation is not merely a good thing theoretically, but an absolute necessity for prevention of health, and worth providing special means to secure.

In considering the subject of ventilation we have therefore to bear in mind the chemical and physical qualities of the air and the various causes of the changes in its composition or characteristics which necessitate its removal. We have also to consider the means available to produce movement of the air in the direction and manner best suited to the requirements, and also the arrangements of inlets and outlets to secure the entrance, diffusion, and exit of air in a manner desirable for efficient results.

When the quality of air to be supplied has been determined, the general principles which govern the arrangements in a room or building to secure its satisfactory introduction and distribution are comparatively simple, but their practical application requires special study of the circumstances and characteristics of each individual building to secure the best results. In other words, the best results are obtained by taking each problem on its merits. As will be shown later no hard-and-fast lines can be drawn governing the application of means of ventilation, but only general principles, because of the different factors to which due consideration must be given.

Carbon Dioxide not Directly Harmful

Until recent years it was generally accepted that the harmful effect of vitiated air was due to the presence of carbon dioxide, but it has been proved by the research work of Dr. Leonard Hill and others that such is not the case. It has been demonstrated that the presence of carbon dioxide in quantities many times what was at one time considered the maximum can be withstood by the human organisms without harmful effect. In present day practice carbon dioxide need only be regarded as an indicator of air vitiation, and the consequent need for a greater or lesser extent of the provision of means of ventilation.

The main conditions rendering an atmosphere unhealthy or uncomfortable are incorrect temperature, excess of moisture, and motionless uniformity.

Touching upon the point of motionless uniformity, or "stillness," as it is more generally termed, and showing its importance upon the general bearing of comfort, it should hardly be necessary to refer to the great relief that is felt by a person in a crowded and stuffy atmosphere gently waving a fan or anything which may be used as such, and so setting the air in motion. The effect is to remove and dissipate the layer of heated air adjacent to the skin, and, although the air set in motion may be regarded as vitiated in that it may be higher in temperature than is considered necessary, and contain a larger percentage of moisture and "carbon dioxide" than required for best conditions, yet the mere movement is sufficient to effect a considerable benefit. We are generally familiar with the apparent relief to be observed by the running of the pedestal type of fan, merely setting the air of a room in motion.

Humidity

It is possible to have a space with what may be considered a low carbon dioxide content more uncomfortable than one with a higher figure if in the former case the air is still and humid and in the latter case of normal humidity and in gentle motion. It is only in quite recent years that much thought has been given to the question of relative humidity and its relationship to comfort for the human being. Relative humidity may be defined as the percentage of moisture contained by air at its temperature compared with what it could contain if saturated. The higher the air temperature the greater the quantity of water vapor required for saturation, as the following three examples will show:—

Air Temperature	Grains of moisture per cub. ft. at saturation
33 deg. F.	= 2.2
60 deg. F.	= 5.72
90 deg. F.	=14.75

It will be seen that air at 60 deg. F. requires to saturate it rather more than two and a half times the weight of water vapour to saturate it at 33 deg. F. When air is heated it will be seen that its percentage of moisture or relative humidity will be lowered, for if air at 33 deg. F. and saturated is heated to 60 deg. F. without coming into contact with moisture it will contain the same weight of water per cubic foot as the initial temperature. The air under this condition at 60 deg. F. would therefore contain 2.2 grains per cubic foot, whereas it could hold 5.75 grains per cubic foot, and therefore it would be stated that the air is 38 per cent. saturated, or has a relative humidity of 38 per cent. Such a condition as this is termed "dry heat," and causes an excessive evaporation of moisture to take place from the skin and respiratory organs. It is for this reason that objection has been raised in the past to the use of hot water, and particularly steam radiators, because the temperature of the air has been raised without the addition of moisture. To overcome this one finds small vessels containing water placed near radiators, gas fires, etc.

The evaporation of water vapour requires a relatively large amount of heat termed "latent heat." The sense of coolness which one feels in an atmosphere where the temperature may be right but the air is very dry is due to the heat given up by the body to evaporate the water from the surface of the skin. On the other hand, if the moisture present is excessive, the heat absorbed from the body is much less, and, when insufficient, a feeling of discomfort is felt.

The ideal method of ventilation should therefore, as far as practically possible, aim at ensuring correct comfort temperature, correct humidity, and gentle motion without in any way creating draughts, which, after all, are air currents moving at high velocity and so causing excessive cooling or evaporation from the skin. In this respect velocity of air movement is of great importance, for air at 60 deg. F. moving at a high rate can be a greater objection than air at a much lower temperature moving more slowly.

Systems of Ventilation

These notes will deal mainly, if not entirely, with mechanical systems of ventilation, and not what is termed natural ventilation. The chief reason is that mechanical ventilation has already become a sine qua non with modern building design and construction, and because with existing buildings mechanical means are applied to overcome the deficiencies of an erstwhile natural system. For a natural system of ventilation to be efficient it would be necessary to design and lay out the building to suit the methods of ventilation, a possibility generally precluded by want of space and the cost of building construction.

In dealing with ventilation problems, and considering particularly this question of air movement, one must take cognisance not only of the velocity of air as it enters the room or space through the various inlets, but also the forward movement of the bulk of the air supplied across the compartment. Take, for example, two rooms or small halls, say, each with the same seating capacity but one being 9 ft. high and the other 18 ft. The air inlets are in each case arranged for the same inlet velocity. There would be greater risk of draught or air motion being noticed and perhaps objectionable in the room 9 ft. high than in the room of 18 ft.

Ventilation problems as they appeal to the designing engineer or contractor may be separated with a fairly well-marked dividing line into two parts, namely, existing buildings and new buildings. Invariably the ventilation of an existing building entails greater difficulties and becomes a greater problem than is the case with new buildings. The primary and chief reason is, of course, the fact that the place exists, and must be dealt with as efficiently as possible with the minimum of structural alteration, or what is generally referred to by contractors as "cutting away and making good," and which can be a very costly part of a complete installation, and may easily reach 25 per cent. to 30 per cent. of the total cost. With new buildings suitable arrangements may be made in the course of construction to facilitate the application of ventilation. Ducts for the passage of the air to the various rooms or points of distribution can be constructed in the walls and floors of brick or concrete. Adequate space in a convenient and central position may be allocated to the plant, and, generally speaking, the whole question becomes much simpler.

Standards of Ventilation

Various standards or requirements according to nature or particular use of the compartment of building to be ventilated have been from time to time named by various authorities, and generally speaking they are based on a definite volume of air per person per hour or a specific number of changes of air per hour.

With regard to the latter, whilst it is termed "number of changes," it cannot be definitely asserted that the space actually has the air completely changed so many times per hour. The statement represents the volume introduced per hour divided by the cubic contents, but it would in most cases be a practical impossibility to ensure that every portion of the air contained in the building is replaced by the new air supplied. The standards of volume may be based upon the maintenance of the carbon dioxide content at a predetermined figure, or upon the necessary amount for the dispersal or dissipation of bodily heat and heat from other sources. It would appear that calculations of volume based upon bodily heat are flexible to a large extent, because the bodily heat in British thermal units is a variable figure depending upon many conditions and circumstances, and it is doubtful whether the theoretical temperature rise upon the air of an apartment due to bodily heat is ever attained. As already mentioned, the amount of carbon dioxide present forms a very useful indicator as to the sufficiency of the ventilation, and its value lies in the fact that the indication is comparative.

Hereunder is given in tabular form the carbon dioxide content when the external air or original air contains 4 parts per 10,000 cubic ft., and certain volumes of this air are being introduced to dilute the carbon dioxide exhalation of the persons present:—

Cub. ft. of Air supplied per person per hour and having Initial Content of 4 parts Carbon Dioxide per 10,000	Total parts Carbon Dioxide per 10,000 showing Air Vitiation
6,000	5.0
5,000	5.2
4,000	5.5
3,000	6.0
2,400	6.5
2,000	7.0
1,800	7.3
1,714	7.5
1,500	8.0
1,200	9.0
1,000	10.0
750	12.0
545	15.0
375	20.0
231	30.0

Ventilation standards may be regarded as affording valuable guidance, but it is not to be supposed that they are rigidly fixed and must be adhered to without variation for satisfactory results. Good results can be, and have been, obtained with volumes below the standards generally given, for so much depends on application. The subject of ventilation is very far from an exact science.

Standard Requirements of Heating and Ventilation

Generally speaking, the engineer tackling ventilation problems must be guided by experience, which forms a very sound and reliable basis to work upon. Standardized regulations which have been drawn up in the United States are useful.

The following table of requirements of ventilation is taken from a valuable American publication:—

Air Changes or Volume to be used as a Basis for Heating and Ventilation Calculations. (J. D. Small.)

Hospitals

Ordinary	35-40 cub. ft. per. min. per person
Epidermic	80 cub. ft. per min. per person
Detention-room	Air change 6 min.
Toilet-room	Air change 6 min.
Bath and duty rooms	Air change 8 min.
Kitchen	Air change 3 min.
Serving	Air change 10 min.
Fumigating	Air change 10 min.
Workshops	25 cub. ft. per min. per person
Prisons	30 cub. ft. per. min. per person
Theatres	20-30 cub. ft. per min. per person
Meeting halls	20 cub.ft. per min. per person
Schools	30 cub. ft. per min. per child And 40 cub. ft. per min. per adult

Hotels

	min. change		min. change
Kitchen	1½-5	Main lobby	20
Restaurant	6	Cafe	8
Billiard-room	10	Retiring-rooms	10
Dining-room	15	All others	15

Laundries should have air change every 4 to 6 mins.

Generally speaking, it will be found that 75 per cent. of the above-mentioned volumes is sufficient to give good results in this country. The London County Council has been working upon a standard of 750 cu. ft. per hour per person for London theatres and music-halls with very good results. Where conditions have favored the use of a smaller volume per person even than this the results have proved satisfactory. It is desirable when considering the volume of air to provide not only to consider the volume of air per person, but also to have regard to the number of changes per hour which the proposed volume will give to the occupied space.

The smaller the cubic contents of the occupied space to be dealt with the greater the number of changes, with the result that the fresh air supplied is brought into more intimate contact with the persons, and this fact alone will often enable a smaller volume to be used to advantage.

Temperature and Humidity

The usual inside temperatures specified in this country are as follows:—

	Deg. F.
Public buildings	60—65
Factories	55—60
Office buildings and residences	63—65
Schools	63—65
Hospitals	65—68

Except in textile mills, where the Home Office stipulates that the relative humidity shall not exceed 70 per cent. approximately and a temperature of 80 to 82 deg. F. dry bulb, 75 deg. F. wet bulb, no specified conditions are at present to be found. It has, however, been found from experience that with a temperature of 60 deg. F. to 65 deg F. a maintained relative humidity of 45 to 50 per cent. gives the best results for comfort. It should be noted that for comfort the higher temperature requires the lower humidity, and vice versa.

The ventilation of buildings, both existing and new, can be carried out by one of three methods or systems. The first is known as the plenum system, or pressure system, and is what may be regarded as a "supply" system only where no special appliances are provided for the exhaustion of the excess of air, the egress of this being through existing openings, such as doors, windows, roof ventilators, etc. Second, there is the exhaust system, which, as the name implies, consists of providing means for the forceful exhaustion of air from the building and leaving the fresh air to replace that exhausted to enter by doors, windows, and any special openings which may be provided. Third, we have the combination of these two systems, which is sometimes referred to as a "balanced" system. As a modification of the last-named method we have what is termed a "recirculating" system, which has been applied with a marked degree of success where conditions have been suitable. The adoption of this system shows an appreciable economy where the ventilation is also used as the means of heating in the winter months. As the name implies, the air supplied to the building is exhausted from the building, and before being returned is washed and cooled and purified. Provision is also made for the addition of a proportion of fresh external air, if necessary, to prevent the carbon dioxide content rising too high.

As to the merits of the respective systems, each has its advantages if care is taken in its application and the needs of the building judiciously considered.

Plenum System

The outstanding features of the plenum system are (1) the pre-determining of the source of fresh air supply; (2) ability to cleanse, purify, and condition the air before delivering it to the building; (3) control of the quantity of air delivered to pre arranged points, and the selection of the points at which the fresh air shall enter. The surplus air must leave through suitable openings, preferably in the upper parts of the room or building. The surplus air will be caused to leave by increase in temperature after delivery and owing to the slight pressure caused by the supply of the fresh air under an initial pressure. This slight pressure has an added advantage in preventing or mitigating draughts through cracks in doors or windows, as the tendency for air movement is rather in an "outward" direction than "inward."

Exhaust System

This method has its particular applications, but should never be used for the ventilation of buildings or rooms in general. The chief reasons are that it is very difficult, if not impossible, to control the fresh-air supply either in its source or temperature and purity. Moreover, there is the liability to draught through every crack and opening. The ventilation of cinemas of smaller size, for example, has been attempted by the placing of one or more exhaust fans in the roof and not providing an adequate or suitable means for fresh-air supply. The result is that during the time a picture is showing very little air-change is taking place, but immediately a picture is concluded and doors are opened there is a great inrush of air.

The exhaust system is eminently suitable for kitchens or workrooms where odours are produced and where it is necessary to prevent these odours from passing to adjoining rooms. In an hotel kitchen with dining-room adjoining the exhaust should be arranged in the kitchen so that any movement of air between the dining-room and kitchen is from the dining-room into the kitchen. The application of the exhaust system for removing odours gives the advantage of enabling the smells to be delivered where they will not create objection should it be necessary or desirable.

Plenum Exhaust System

As already stated, this is a combination of the two above-mentioned, and would be used where the plenum system alone is likely to fall short of requirements owing to severe conditions or inadequacy of the means existing to allow the excess air to get away. In such cases where the combined systems are applied the volume of air exhausted should be less, generally about three-quarters or two-thirds of the quantity of air supplied, to maintain the advantages of the plenum system.

Recirculating System

This system, as already hinted, offers its chief advantage in the one word "economy," which applies to capital cost and running cost. Under the first heading it will be seen that one fan is applied in place of the two necessary with a plenum and exhaust system, as the recirculating system is a combination of both. This also gives a saving in motive power for driving the fans. Then, in the winter months the cost of raising incoming fresh air to the desired temperature is obviated except in regard to the small proportion which is sometimes admitted. This system has now advanced beyond the experimental stage.

For the air supply the following plant is necessary:—

(1) Fan, with means to drive it—generally an electric motor.

(2) Primary, or pre-heater, operated generally by low-pressure steam or hot water.

(3) Air filter.

(4) Final heater.

(5) Air delivery ducts, with outlets at suitable places and dampers or means of regulating the air supply to different points.

The above items may be considered to comprise a complete plenum system, but a further addition may be made in the adoption of automatic control of temperature and humidity. Where capital cost has to be seriously limited it is customary to have one heating battery and to eliminate the air filter or provide some means at comparatively low cost for partially filtering the incoming air before delivery to the building. In factory installations the filter is often entirely omitted. In public buildings the inclusion of an efficient filter is not only essential from a health point of view; it can also be demonstrated that the adoption of a filter should not be considered a luxury, but that it is of financial value. In large buildings the saving in costs of periodic redecoration is very considerable, and in the case of cinemas, theatres, etc., there is no doubt a number of people who will patronize the house which provides the greatest comfort in preference to another, and must in course of time thereby produce increased revenue. There is no doubt that a stuffy or badly ventilated theatre or cinema will counteract to some extent the "draw" of a good programme, for the public is most certainly learning to discriminate on this question.

Selection of size of fan is based upon the volume of air to be handled, the resistance to be overcome in getting the quantity of air necessary through the system to the points of distribution, and lastly, reasonably silent operation. The type of fan best suited to a plenum supply system is the centrifugal type cased fan. The propeller type of fan is unsuitable for overcoming much resistance, and should therefore not be used for drawing through or blowing through long lengths of duct or other apparatus comprising the installation, all of which offers resistance to passage of the air.

Another point which has to be borne in mind when using this type of fan is that the insertion of resistance in the air circuit with a consequent reduction in volume increases the load upon the fan motor, assuming, of course, the speed remains constant. This increase can be as much as three times the normal load. This is the reverse of what takes place with the cased-type fan, which with an increase in resistance and consequent reduction in volume absorbs less power. It should also be borne in mind that there are invariably at least two sizes of fan for a specific duty. The larger one will operate more silently and will show a lower operating cost, but, of course, the capital outlay involved is rather more. The difference in cost, however, is often quickly recovered by the saving in operating cost.

Technical points involved in selecting size of fan are beyond the purview of these notes, and are much better left to the ventilating engineer and the fan manufacturers. The installation has to be designed first, and the size of fan is practically the last thing to be considered and settled upon.

Silent operation is governed by fan design and speed, not only in revolutions per minute, but in velocity of the air movement through the fan. It will generally be found that fans of the multivane type are more silent in operation than the paddle-wheel type.

The primary, or pre-heater, is sized from the volume of air to be dealt with and the temperature through which the air has to be raised. The object of the pre-heater is to raise the temperature of the incoming air before it comes into contact with the water of the filter, thereby causing the air to pick up moisture and so provide that the air is delivered with a desirable relative humidity. In this connection it is also sometimes necessary to warm the water of the filter by means of a calorifier or other suitable means.

The air filter, to obtain the best results, should be of the water-spray type. These have now been brought to a high state of efficiency, and, moreover, in the type which operates by the circulation of a large quantity of water—amounting to as much as 5 gallons per 1,000 cubic ft. per minute—a very valuable cooling effect of the incoming air is obtainable during the warm summer weather. The water is recirculated by being passed through filters of the strainer type before coming into contact with the air a second time. This operation is generally performed by a pump of the centrifugal type. Operating under such conditions, filters will give as much as 70 per cent, to 90 per cent. cooling of the difference between the dry and wet bulb temperatures of the incoming air. To demonstrate this by figures, we will assume that the air is entering the washer at 75 deg. F., 50 per cent. relative humidity. The wet bulb temperature of this air condition is 62 deg. F., and the air may be expected to leave the washer at a temperature of 63 to 66 deg. F. Greater cooling than this may be obtained by lowering the temperature of the washer by means of ice or refrigeration coils. As an alternative, when available, use may be made of artesian well water, which will generally be at temperature between 45 deg. F. and 55 deg. F.

The final heater is used to raise the air in winter to the desired temperature. This final temperature will depend upon whether the building is heated by other means, and it is therefore necessary to raise the incoming air temperature to about the desired temperature in the building. If, on the other hand, use is made of the ventilation air for warming the building, the air must be raised in temperature sufficiently to take care of the radiation losses, and after having given up this heat, remain at the desired room temperature.

It is generally preferable that radiator heating be provided for entrance halls and corridors, and to supply part of the heating for the main portions of the building. This obviates the need for the air delivered by the ventilation system being raised to too high a figure.

Arrangements are made in conjunction with the air filter and pre-heater to ensure that the air leaves the washer at 50 deg. F. to 55 deg. F. saturated and when this air is reheated on the final heater to the desired temperature it will have the correct humidity for comfort.

The automatic control to which reference has been made is used to control automatically the temperature of saturation of the air leaving the filter, and also to control the two heating batteries. Automatic control is effected either by control of the rate or quantity of flow of steam or hot water to the heating batteries, or by automatically controlling air dampers which vary the amount of air passing through the heater and by-passing the remainder.

(To be continued)

Economies Possible in House Painting

By Cornelius T. Myers in "Mechanical Engineering"

In the realm of house painting there seems to be a great possibility for economies, either by the use of cheaper paints which will give the necessary protection, or by the use of paints which will last longer. The writer is not familiar enough with this subject to warrant any comments other than to refer to Dr. A. H. Sabin's letter to the Engineering News-Record of August 18, 1921, in which he states that even the Pennsylvania Railroad is not always able to protect itself in the matter of paints, and he asks what chance the ordinary citizen has to check up on the paint he should use to protect the house that very possibly represents his life's savings. Paint literature of a technical nature is of no assistance to the average man, and is quite inadequate to explain the why and wherefore of much present practice. Great differences of opinion and some vague reasoning appear. Many contentions seem to be based on a desire to use certain materials or formulas, rather than on comparative service data of a reliable sort. Such men as Dr. Sabin of the National Lead Co., and Dr. Holly of Acme White Lead and Color Works, made frank acknowledgment of the shortcomings of paint technology and totally disavow any detail information concerning the effect of paints on moisture-proofing the cell structure of woods of various kinds. The Engineering Foundation has approved the desirability of this research and has appointed a committee to report ways and means of furthering it. This is a most substantial endorsement. The Society of Automotive Engineers and the American Institute of Architects have also approved and will lend their support.

It would seem that an intimate knowledge of wood cell structure is essential to any investigation of this subject. The Forest Products Laboratory is by all odds our most authoritative source of information on woods and their structure. The director and his staff have been interviewed and fully agree that this research would be productive of important results, some of which could be expected in the course of 8 to 12 months; also that it can be handled there if funds in a very modest amount, between $10,000 and $20,000 per year, were made available for, say, from five to ten years. The Bureau of Standards has a paint division and has funds to work on the paint end of the research. Doubtless a co-operative arrangement could be made between these two of the most capable and helpful arms of our governmental service. Doubtless too, the technical heads in the paint and varnish trade would place at the disposal of the Bureau of Standards and the Forest Products Laboratory their great fund of knowledge of paints and oils. Many of these men are already working on this problem, as has been set forth above; but they are handicapped by a lack of intimate knowledge of the various kinds of woods, and they are very much limited both in the time they can give and in the range of materials which they can test.

There is a crying need for such information, and inside of a year after the work is started a considerable amount of usable data should be forthcoming. The difference between the insignificant cost of the research and its value to the country at large is so vast that the writer believes it is only necessary to call attention to the matter in order to institute a widespread demand for action.

How Contractors Can Help to Alleviate the Freight Car Shortage

Contractors have been experiencing a great deal of trouble recently on account of the pronounced car shortage on the railways. Those who have been depending on rail transportation for their supplies have frequently been subjected to delays that have seriously tied up jobs and interfered with contracts. The situation is still acute enough that the Railway Association of Canada is urging all those who have need of using the railways for transportation of commodities to help out the carriers by unloading cars as quickly as possible and by returning them loaded to maximum carrying capacity. Contractors, we know, will be willing to do everything in their power to alleviate the situation and for that reason their attention is drawn to the following comments of the Railway Association on the matter of freight car supply:

The attention of executives in all Canadian concerns interested in shipping or receiving shipments of goods without undue delay, is drawn to the reasons for the increasing car shortage, the effect on this situation of the recent coal and railway strikes in the United States and the growing necessity for public co-operation to offset the difficulty.

In the first place, the improvement in business conditions has increased the demand for cars.

Secondly, the railway strike has so hampered rail operations in the United States that Canadian cars entering that country are only with difficulty being recovered. At the present time there are approximately 24,000 more Canadian box cars in the United States than United States cars of a similar class in Canada.

And third, in addition to this factor of impaired railway service, the recent termination of the coal strike throws on the American railways a suddenly increased demand for cars and motive power to move accumulated orders for coal. This makes it even more difficult for the Canadian roads to keep down the number of their cars on foreign rails.

To meet the situation, the Railway Association of Canada has made special direct representations to Washington and obtained assurances that the United States railways will do their best to hurry the return of our cars; and the Canadian roads, through this Association, will maintain constant pressure to see that this is done. Furthermore, the dwindling supply of cars will be offset as far as possible by the usual effort of our roads to move cars faster and farther and thereby make each car carry more in a day.

In spite of the railway's best efforts, however, the shortage is becoming daily more acute.

One great factor in car economy lies out of the railways' control—and in your hands, or the hands of your shipping and receiving departments. If on your instructions they will take pains to load more goods in each car and release cars promptly, you will help protect your plant and your neighbors' plants against the further danger of car shortage.

Even if it takes your staff a little more time to load outgoing cars to utmost capacity—and

Even though you may already be releasing cars well within the free time limit—

It will pay to increase this shipping efficiency still further and co-operate with the roads.

United States traffic is from 5% to 17% heavier this fall than last fall, quite aside from strike accumulations of shipments. Canada appears to be following suit. To share in returning prosperity it is essential to help protect your own car supply.

Electrification of the Railway System of the Montreal Harbour

In 1912 the work preparatory to the electrification of the railway system of the Montreal Harbour was commenced. An appropriation of $50,000 was then voted for that purpose, but owing to the war, the work was delayed until 1918 when it was proceeded with again. The system is now completed and ready for operation. It extends for a distance of 9 miles along the water front and comprises a total length of 45 miles of single track. The total cost of the system was approximately $400,000.

The power necessary for the operation of the system will be supplied by the Montreal Light, Heat and Power Company and comes partly from Shawinigan Falls and partly from Cedar Rapids. Two electric locomotives will be used for the present and will have a traction power of 1,200 tons on a 1 per cent. grade at a speed of 15 miles per hour.

Twenty Year's Review of the Cement Industry

A progress review of the portland cement industry, over a period of twenty years, has just been compiled by the Portland Cement Association in commemoration of its twentieth anniversary meeting. This survey is presented in a very attractive booklet, which indicates, by suitable articles and illustrations, the great advance that has been made in the use of portland cement. A sketch of the association itself and of the success with which it has promoted the use of concrete is a leading feature of the contents, but in addition there are articles that describe the developments in the manufacture and scientific study of portland cement and also the laboratory and technical research work that is now so important a feature of the Portland Cement Association's activities. On the whole, the booklet is a splendid record of a few of the notable achievements in the advance of concrete construction to a place where it is now in universal favor.

Arena at Lethbridge

Mr. Thomas Stubbs, contractor, Lethbridge, Alta., has been awarded the contract for the erection of a new skating arena at Lethbridge, which will measure 117 by 220 ft., have a seating capacity of 2,000, and will be of frame construction on concrete foundations. The roof will be carried by 104 foot steel trusses on 12 by 12 posts. The cost is estimated at $20,000.

Moose Jaw Contractors Consider Standard Contracts

At a meeting of the Association of Building & Construction Industries of Moose Jaw, Sask., held on November 25, at the Builders' Exchange, the standard form of contract published in a recent issue of the Contract Record, was discussed. The subject will be more fully considered at another meeting, at which time the association will also make arrangements for the annual meeting and banquet and will elect officers for the coming year. Mr. J. A. McKellar, one of the board of directors, presided in the absence of the president S. Pritchard. The secretary-treasurer, H. E. Wenman, was also present.

A New Type of Compressor

A new type of compressor manufactured by the Canadian Ingersoll-Rand Company, Ltd., Sherbrooke, Que., is completely described in Bulletin K-311, recently issued by that company. These new machines are known as class ER-1, single stage, straight line, belt-driven air or gas compressors. Among the features which are incorporated in these machines are plate inlet and discharge valves; enclosed construction with automatic combined flood and splash lubrication: forged steel connecting rods and crank shafts and removable die-cast bearing shells. These compressors are particularly adapted to small mines, quarries, foundries, machine shops, textile or paper mills and industrial plants generally.

Link-Belt Catalog

A new Link-Belt portable loader catalog has just been issued by the Canadian Link-Belt Company, Toronto. The catalog which covers their entire line of portable equipment is the most up to date and complete ever issued by this company. It is 8½ x 11 in size and contains complete specifications of all of the standard machines which include the large one-man power swiveling loader, the portable belt conveyor, the standard type "A" machine for anthracite coal, and the "CS" loader for handling sand and gravel.

Lefroy Engineering Co. is Moving

The H. C. Lefroy Engineering Co., have moved their office from the Ryrie Bldg., Toronto, to new and larger premises at 11 Leader Lane.

The Mount Royal Hotel to be Opened on December 20

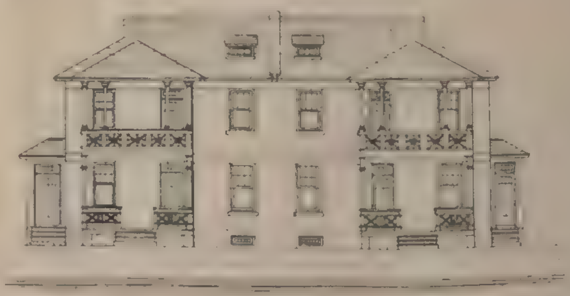
The largest hotel in Canada, the Mount Royal in Montreal will be officially opened a week from today

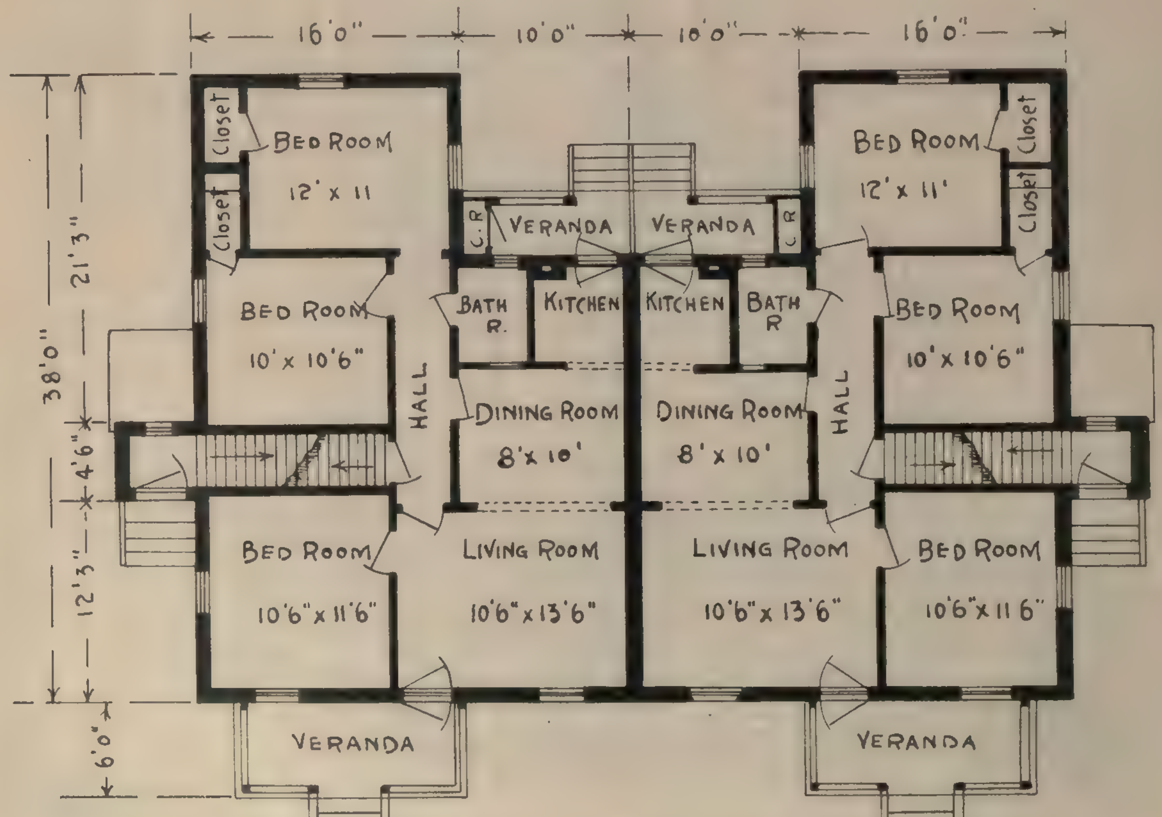
The Contract Record's

Weekly House Suggestion No. 48

The house illustrated in this week's suggestion is one of the numerous houses now in course of erection in most of the suburbs surrounding the city of Montreal and was built by the Metropolitan Housing Company, Ltd., of that city, according to the approved general plans of the Quebec government. Mr Alcide Chausse, architect of Montreal, was the designer.

This semi-detached house, containing four residences, is built of solid brick and cost $14,000. It is divided into two sections by a cement wall, extending from the basement floor to above the roof and closes communication between the two sections in case of fire. The interior layout of each of the four residences, two downstairs and two upstairs, is identical, with the exception of the entrances, those of the lower residences being in the front whereas the upper residences have their's on the sides. Each residence contains six rooms and bath and also front and back verandahs of comfortable size. The bedrooms are large and well ventilated and are provided with roomy wardrobes. The parlor and dining room are separated by an arch and there are two more openings to the dining room, one from the kitchen and one in the hall leading to the back of the house. A cold storeroom is also provided at the back of each residence. All interior walls are finished with plaster and all floors are hardwood, except those of the bathrooms, which are finished with tile. The roof is covered with asbestos shingles. The basement contains storerooms and furnace room. Hot air is the heating system used and each residence has a separate system. The access to the cellar for the occupants of the upper floor is by stairways conveniently placed behind the entrance porches. The total dimensions of the house are 52 ft. frontage by 38 ft. in depth.





Tile on the Muskoka Hospital

In a recent issue of the Contract Record an announcement appeared concerning the Don Valley Brick Works, featuring the Muskoka Hospital for Consumptives, in the construction of which 1,340,000 Don Valley brick were used. It might also have been mentioned that the fireproofing tile used in the construction of this building was the product of the same company.

Building Costs Higher in the East

The cost of building construction in New England has advanced 27 per cent since January 1, according to the Massachusetts department of labor. Building costs on January 1, were 51 per cent above those of December 1, 1914, and are now 92 per cent above pre-war basis.

Mainly Constructional

East and West—From Coast to Coast

In a report submitted recently to the Elgin County Council by Reeve H. Dromgole, chairman of Good Roads Committee, it was shown that the sum of $125.23 was expended on the construction and improving of the highways of Elgin County, Ont., during the year of 1922. Over 140 miles of road was re-surfaced with broken stone or pit gravel. This work was additional to that completed by the Highways Department this season.

A bad fire in Terrebonne, P. Q., recently, destroyed 162 houses and resulted in a loss estimated at between $800,000 and $1,000,000.

A start was made on the new Ford building, at Ford, Ont., a few days ago. The building will be a 1,000 x 600 ft. structure. Messrs. Merlo, Merlo and Ray are doing the excavating and Wells & Gray, of Windsor, are the general contractors. This building will be utilized as a machine shop and is the first of an extensive program of additions and improvements to the Ford plant.

Among the by-laws which the citizens of Toronto will likely vote on at the next elections, on January 1, is one authorizing the expenditure of $255,000 on a memorial stadium.

The township of Sandwich South has placed at the disposal of the farmers in that district the sum of $75,000, from which they may borrow for the purpose of tile draining their lands.

Messrs. Jobin & Genois, 133 Abraham Hill, P. Q., are building a marble factory at Riviere a Pierre, P.Q. The building will be a one-storey structure, 35 x 200 ft., and will cost $25,000.

The municipal committee at Victoria, B. C., has adopted the Town Planning Act, but recommends that it be not made compulsory.

About ten miles of asphalt pavement were laid in Hamilton during the past season, The total has reached about 165,000 square yards, while the area laid last year was about 111,000 square yards. About 8,700 square yards of this year's area were laid at the new highway entrance.

Only two tenders were submitted on the proposed new incinerator plant on the site of the western cattle market, Toronto, one at $203,000 and the other $227,910. The city has taken no action as yet.

This year's annual meeting of the Provincial Builders and Supply Association, of Ontario, will be held at London, on January 16 and 17. Some important questions are to come up for discussion at this meeting, including the formation of an accident preventative association, the shortage of tradesmen in building industries and ways and means of getting more apprentices to enter the building trades.

More than one hundred houses and other permanent buildings are being erected in Haileybury. The town, which was practically wiped out, is being rebuilt on plans prepared by competent town-planing engineers. The Ontario Government Housing Commission is loaning $300,000 to the town under reasonable terms and the provincial government is giving 3,500 feet of lumber to every fire victim who makes application through the relief committee. All that is possible is being done to rehabilitate the fire victims, and the T. & N. O. is still carrying relief supplies free.

The City Council of Toronto, at a special meeting a few days ago passed by-laws providing for the widening of Bloor Street to 86 feet between Sherbourne Street and Spadina Avenue at an estimated cost of $1,500,000. The city at large will pay 60 per cent of the cost and the property owners benefited, 40 per cent. The work will not be commenced until May of 1926. The passing of the bylaw was necessary to prevent the erection of new buildings on the old street line.

Personal

Mr. Thomas Drinkwater, 24 Frater Ave., Cedarville, Toronto, has severed his connection with the firm of Drinkwater & Sagar, concrete contractors.

Mr. Samuel Gompers, president of the American Federation of Labor, is coming to Montreal on December 18 to inaugurate an organization campaign of all local building trades.

Lt.-Col. C. P. Meredith, architect, of Ottawa, has been awarded first prize in the competition arranged by the Historical Monuments' Branch of the Interior Department for a suitable design to mark the historical sites of Canada. W. L. Sommerville, architect, Toronto, was second, and an architect from Winnipeg, third. About 60 architects and artists from all over the Dominion competed. The judges were Prof. Percy Nobbs, architect, Montreal; M. A. Marchand, architect, Montreal, and Mr. Homer Watson, artist. The prizes were $250, $150 and $100. The design of Col. Meredith is in the form of a shrine 10 feet high, four feet at the base, with an inset panel for a bronze tablet explaining the significance of the monument. The shrine is surmounted on three steps, symbolical of the three peoples, the Indians, the French and the British. About 300 monuments will be erected in Canada, it is expected. The exact spots for these monuments have not yet been chosen, but they will mark important events in the historical and industrial life of the Dominion.

Obituary

Mr. J. Riley, a contractor of St. Catharines, Ont., died recently from injuries sustained in a motor accident on the Thorold-Niagara Falls highway.

Trade Incorporations

Dufresne Construction Co. Ltd., with head office at Montreal, capital $50,000, to carry on a general contracting business.

Ontario Shale Brick, Limited, with head office at Hamilton, capital $100,000, to manufacture and deal in shale brick and other shale and clay products.

Ideal Contracting & Building Co. Ltd., with head office at Toronto, capital $300,000, to carry on the business of general contractors.

CONSTRUCTIONAL ACTIVITY

Period of Dec. 6 to Dec. 12, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Collingwood, Ont.
Town Council contemplate sewer extensions in East Ward. A. Mayer, clerk.

Dundas, Ont.
Town Council contemplate construction of watermains on York Rd.

Town Council plan construction of sewer on South St. Mr. Murdock, Engr.

Galt, Ont.
Public Utilities Cmsn. contemplate waterworks extensions. James, Proctor & Redfern Ltd., Engrs., Excelsior Life Bldg., Toronto.

Hamilton, Ont.
City of Hamilton and Barton Twp. Councils plan construction of road on Colquhoun property from Hamilton to Sanitorium.

London, Ont.
Plans are being prepared for asphalt pavements to cost $200,000 for City. H. A. Brazier, City Engr.

Plans are being prepared for storm sewer to cost $85,000 on Tecumseh Ave. and Wharncliffe Rd. for City. H. A. Brazier, City Engr.

Milton, Ont.
Construction of sewage system is contemplated by Town Council. G. A. Hemstreet, clerk.

Montreal, Que.
City Council plan construction of boulevard at cost of $500,000 on Monkland Blvd. from Queen Mary Rd., at Snowdon Jct., to Town of St. Laurent.

Ottawa, Ont.
City Council plan construction of watermains on several streets. A. F. Macallum, Commr. of Works.

Stephen Twp., Ont.
Construction of drainage system is contemplated by Twp. Council. G. A. McCubbin, Engr., 135 King St., Chatham, Ont.

CONTRACTS AWARDED

Hamilton, Ont.
General contract for construction of pipe sewers on Simcoe St. for City is awarded to J. J. Armstrong & Sons, 116 Burris St.

General contract for pipe sewer on Hunter St. for City is placed with Scanlon Moyer Ltd., 995 Barton St. E.

Contract for pipe sewer on McNulty Blvd. for City is placed with J. J. Armstrong & Sons, 116 Burris St.

Port Nelson, Ont.
General contract for construction of watermains costing $6,000, and sewers, $5,000, for Hughes Cleaver, Carolina St., Burlington, is awarded to Canadian Engineering & Contracting Co. Ltd., Home Bank Bldg., Hamilton. MacKay & MacKay, Engrs., Home Bank Bldg., Hamilton.

Railroads, Bridges and Wharves

Courtenay, B. C.
Plans are being prepared for bridge to cost $25,000 for Prov. Gov't.

Richibucto Parish, N. B.
P. J. Veniot, Min. Dep't. Works, Prov. Gov't., will receive tenders until Dec. 18th for construction of East branch St. Nicholas River mouth bridge. Plans with Dep't., office of Prov. Tax Inspector, Bank of Montreal Bldg., St. John, and Martin Lannigan, Rexton, Kent County. Certified cheque for 5% of tender required.

Saskatoon, Sask.
Addition to station will be erected at cost of $7,500 by C. N. Rlys.

Weldford Parish, N. B.
P. J. Veniot, Min. Dep't. Pub. Works, Prov. Gov't., will receive tenders until Dec. 18th for construction of bridge. Plans with Dep't., office of Prov. Tax Inspector, Bank of Montreal Bldg., St. John, and Martin Lannigan, Rexton, Kent County. Certified cheque for 5% of tender required.

CONTRACTS AWARDED

St. Apollinaire, Que.
General contract for construction of iron bridge at cost of $7,122 for Town is awarded to Aubin, Beaudet & Boucher, St. Antoine de Tilly.

St. Catharines, Ont.
General contract for erection of steel bridge for City is awarded to Standard Steel Construction Co., 55 Main St. E., Welland.

Public Buildings, Churches and Schools

Arnprior, Ont.
Erection of addition to high school at cost of $50,000 is contemplated by High School Bd. M. Graham, secy.

Burlington, Ont.
J. A. Armes, architect, 67 Charles St., Hamilton, is preparing plans for addition to school for Bd. of Education.

Etobicoke Twp., Ont.
S.S. No. 11, Etobicoke Twp., will erect a school at cost of $35,000. Walker & Gibson, architects, 70 Victoria St., Toronto.

Fairville, N. B.
Prov. Gov't. contemplate electric wiring to cost $6,000 at Prov. Gov't. Hospital.

Hamilton, Ont.
Plans are being prepared for alterations to church to cost $25,000 for Livingston Methodist Church Congregation. Geo. T. Evans, architect, Clyde Block.

Hamilton Beach, Ont.
Erection of church is contemplated by R. C. Corp. Rev. Father Cleary, Pastor.

Leamington, Ont.
Erection of community hall at cost of $25,000 is contemplated. R. A. Logan, Chrm. of Comm.

London, Ont.
Erection of dormitories is contemplated by Western University. John M. Moore & Co., architects, 489 Richmond St.

Montreal, Que.
Societe Catholique de Protection & de Renseign'ts contemplate alterations to bldg. for Hospital. Mr. Hurtubise, Pres., 2 Place D'Armes Sq.

North Vancouver, B. C.
Erection of school costing $7,000 is contemplated by North Vancouver District School Bd. Blackladder & MacKay, architects, 509 Richards St., Vancouver.

Ottawa, Ont.
Erection of addition to school is contemplated by Pub. School Bd., Gilmour St. W. C. Beattie, Sup't. of Bldgs.

Pembroke, Ont.
W. C. Keighley, architect, 156 Pembroke St. E., has prepared plans for school to cost $100,000 for Pub. School Bd.

Sherbrooke, Que.
Erection of high school at cost of $100,000 is contemplated by School Bd. H. C. King, secy., City Hall.

Terrebonne, Que.
Town Council will rebuild fire hall which was destroyed by recent fire.

Dom. Gov't., Dep't. Pub. Works, will rebuild post office.

Toronto, Ont.
J. M. Cowan, architect, 107 St. Vincent St., is preparing plans for addition to St. Anthonys School for Separate School Bd., 477 Jarvis St.

CONTRACTS AWARDED

Birchcliffe, Ont.
A. Gordon, Queensbury Ave., has masonry contract for memorial hall costing $20,000 for Scarboro Twp. Veterans Ass'n.

Galt, Ont.
Geo. H. Thomas, Galt, is awarded general contract for erection of addition to Collegiate Institute costing $300,000 for Bd. of Education. Cameron & Ralston, architects, Bartlett Bldg., Windsor.

Lachine, Que.
Additional contracts for school costing $300,000 for School Bd., are: Steel, Dominion Bridge Co. Ltd., Dominion Station, Lachine; electrical, Philip Lahee & Co., 20 St. Nicholas St., Montre-

ESTABLISHED 1886

Contract Record
and Engineering Review

A National Journal for the Construction Interests of Canada,
reaching Architects, Engineers, Contractors
Municipal Officials, etc.

Published Each Wednesday by
Hugh C. MacLean Publications
LIMITED
THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700
Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL - 119 Board of Trade Bldg.
WINNIPEG - 302 Travellers' Bldg.
VANCOUVER - Winch Building
NEW YORK - 296 Broadway
CHICAGO - 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES
Canada, Great Britain and British Possessions $3.00. U. S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, December 20, 1922 No. 51

The Apprenticeship Problem

No denial will be offered to the statement that apprenticeship is one of the most pressing problems of the construction industry to-day. Contractors have deplored the situation; economists have recognized its seriousness; and the governments have sensed the need of some remedy. And yet the problem exists without any earnest attempt having been made to effect a solution. True, suggestions, many of them unfortunately vague and indefinite, have been offered, and schemes more or less elaborate have been worked out on paper, but the fact remains nevertheless that definite, concerted, result-producing action has been conspicuously absent. Individual attempts have been made to increase the number of apprentices and give them effective trade training but the industry as a whole, while recognizing the need and demand for skilled mechanics, has somehow or other remained inert.

Something must be done, however. The shortage of skilled building mechanics is becoming so serious that an actual curtailment of building programmes has been experienced frequently during the past year, not to mention the extremely high wages and the lack of production that a labour scarcity always entails. In addition, the superabundance of unskilled building labour offers a problem that is somewhat related to and must be solved along with the other question. Just at this season this last fact takes on serious proportions, for winter only accentuates the trouble incident upon having a large floating population of untrained workers on our hands. Unemployment relief, government doles, or other measures have been developed to afford some means of helping to absorb these men who are so unfortunate as never to have learned a trade.

Never have learned a trade! That fact is surely suggestive, is it not? Does it not indicate a possible way to work out a solution to these problems—to decrease the over-supply of unskilled laborers and to increase the under-supply of skilled mechanics? Surely there is good material among the unskilled workers if they were given an opportunity to learn a trade. Surely they would, if a spark of ambition lingers in their make-up, be glad of a chance to better their positions, and to increase their wages. This idea, with so great a possibility of effective results, has been incorporated in a new scheme for the solution of the apprenticeship problem which is detailed on another page of this issue. It must be emphatically stated, however, that this scheme is far more than a suggestion that skilled workers be drafted from the ranks of the unskilled—that is only one element of a very comprehensive plan that seems to offer greater promise than any that has yet been propounded.

This scheme is heartily endorsed by both the Association of Canadian Building and Construction Industries and the Provincial Builders and Supply Association of Ontario, and it must be regarded as the joint scheme of both these organizations, although credit must be in all fairness be given to the originator, J. M. Pigott, one of the best known general contractors in Canada, who has been closely allied with all deliberations that have taken place in connection with apprenticeship and who can speak with the authority that an intimate knowledge of the problem has developed.

It is not the purpose of this comment to do more at this time than draw attention to the scheme as outlined on another page and to commend the article as worthy of our readers' most serious thought. Just let us emphasize the importance of deriving as soon as possible a solution to the apprenticeship problem by quoting Mr. Pigott: "The main thing, of course, is that mechanics are not being trained under the present system. The existing system is in the discard, absolutely, so far as results are concerned. A new scheme that will accomplish the purpose has to be set up and that without delay." Such a scheme is the one outlined, which has the endorsation of the Dominion and Ontario contractors' organizations. Will our readers express their opinion of it so that before the forthcoming construction conferences something definite and tangible will be prepared on which action may at once be taken?

Preservation of Building Timbers

Fence-posts, barn-sills, house-frames and other timbers placed without preservative treatment in contact with the soil give only a few years of service and the cost of replacing such timbers is increasing every year. Material is harder to obtain and labor is more expensive. In order that the longest possible service may be obtained from woods used for such purposes the Forest Products Laboratories of Canada, Forestry Branch, Department of the Interior, have for sev-

Appreciation

And now, in the friendly spirit of a merry Christmas, accept this expression of appreciation for your business and courtesies of the past. May that light which illumines the road to health, prosperity and happiness burn steadily for you through all the New Year.

Hugh C. MacLean
Publications

eral years investigated such preservative methods as could be practiced by the farmer and builder. Treatment of timber in open tanks, that is to say, without pressure, is the only feasible plan for a man who is not in the wood-preservation business. A creosote oil suitable for such a process was formerly so expensive as to make the preservation of timbers appear a questionable economy, but owing to representations made by the Laboratories to the manufacturers of creosote oil in Canada it is now possible to get an oil of the correct specification at a very reasonable price. The preservation of farm and other timbers is therefore no longer a matter of enterprise but of ordinary business sense. Particulars as to the oil or process may be had from the Forest Products Laboratories of Canada, McGill University, Montreal.

Extension of the Building Season

Extension of the building season in order to reduce or eliminate unemployment among workers engaged in the industries concerned was urged at a special general meeting of the Montreal Builders' Exchange held on December 6. Other matters dealt with included a proposal for the registration at the City Hall of all those engaged in the building trades in Montreal, in order that small as well as large contractors may bear their fair share of taxation, and the desirability of establishing better co-operation between general and trade contractors. Various allied associations including the Master Plumbers' Association, the Master Painters and Decorators, Association and the Electrical Co-operative Association, were represented at the meeting, which was presided over by K. D. Church, president of the Builders' Exchange. Supporting him were two vice-presidents, A. T. Alexander and H. Vincent.

More Contented Workers

John Quinlan, in the absence of J. P. Anglin introduced the subject of seasonal employment in the building trades. Mr. Quinlan pointed out that up to quite recent times building had been carried on in Montreal during only six months of the year, with the result that attempts had been made to crowd into that period activities that might have been spread over the whole year, while contractors had found it difficult to obtain an adequate supply of skilled mechanics for the work in hand. Of late years, however, the building season had been extended, aand Mr. Quinlan, speaking as a general contractor of many years' experience, said that he did not know of any difficulties which should prevent buildings especially those of a monumental character, together with work on roads and sewers, from being carried on throughout the whole twelve months.

Steady employment throughout the year would also mean contented workers, said Mr. Quinlan, and while he did not advocate a lowering of wages, they must bear in mind that when certain trades approached them for higher wages the men and their representatives always brought forward the argument that they were able to work only a part of the year and, therefore, had to secure during that time wages sufficiently high to carry them over the period in which they were idle.

Mr. Quinlan said that the Builders Exchange could do much good work in educating municipal and governmental authorities, and public bodies, such as school boards, to lay their plans for projected buildings in the fall of the year, and not in the spring as is now usually the case. He said that he did not believe that buildings erected in the winter time cost any more than those constructed in the summer.

Compulsory Registration

A. Plamondon and C. M. Morssen both urged the compulsory registration at the City Hall of all those engaged in the building trades, so that all those who were making a business of the industry should pay an adequate share of the business taxes imposed by the city. It was stated that under present conditions many came from outside points, availed themselves of the various privileges provided by the taxpayers, completed their respective jobs and then returned whence they came thereby escaping their proper share of the city's burdens. Naturally such contractors could afford to take work at a lower price than others who paid taxes to the city while the community itself suffered also.

J. A. Anderson, speaking on the subject of closer co-operation between general and trade contractors, said that there seemed to be a notable lack of such co-operation at the present time. He said that if there were more co-operation between the respective contractors the building public would be the gainers by better work at less cost.

E. Dussard advocated the testing of ceramics and other tiles.

Will Erect Large School in Montreal

The Protestant Board of School Commissioners have bought the block of land in Emard Ward, bounded by Rielle, Jacques-Hertel, Angers and De-Biencourt streets and an up-to-date school will be erected on this property to give accommodation to the fast growing needs of this section. The population already exceeds 12,000, and when the city has completed the public works in hand, an increase is sure to follow. The Board has two schools at present; these will be merged into the new one, and the present buildings disposed of.

The city of Montreal has taken over the property which starts at Queen Mary Road, at Snowdon Junction, and runs to St. Laurent—generally known as Decarie Boulevard. It is a continuation of Decarie Avenue, in Notre-Dame-de-Grace, but appears under the name of Monkland Boulevard on the city's plans.

The city, by its decision, will make the boulevard 100 ft. wide for its full length. This will give the west end of the city a main road direct from Upper Lachine Road to Cartierville, and will be to the west end what St. Lawrence Boulevard is to the eastern section. The opening of the boulevard will probably make an immediate improvement in the real estate values of all the land in Notre-Dame-de-Grace, St. Laurent and Cartierville.

The Grand Trunk Railway will traverse the boulevard by their line which runs from Jacques-Cartier Junction, used by them largely for transferring freight to and from the Canadian Pacific Railway. The Canadian Pacific Railway passes under the boulevard with its passenger trains which run from Windsor Street to Quebec and the Laurentian Mountain lines. The race tracks and polo grounds will now be reached by a wide, well-paved road, and St. Laurent should immediately show an increase in population on account of this boulevard's construction.

How Can More Skilled Mechanics be Obtained?

A Suggested Remedy for the Apprenticeship Problem that has the Endorsation of the Dominion and Ontario Contractors' Associations—Present System Ineffective

By **J. M. PIGOTT**
Pigott-Healy Construction Co., Hamilton, Ont.

The shortage of properly trained building mechanics is quite the most important problem before builders today. Men who could see ahead a few years began four or five years ago to warn us of just what we are experiencing today. During these last two years, with the labor scarcity and its attending evils well upon us, plenty of consideration has been given it, but no plan or remedy that has been put forward offers any relief.

It is hardly necessary to enter into a description of conditions as they are. All builders are now quite familiar with them. The outstanding facts, however, are briefly:—

1. Building mechanics in all trades are not present in either Canada or the United States in sufficient numbers to take care of the work to be done. This is more extreme in certain trades such as plastering and bricklaying.

2. Such mechanics as there are, are much poorer in production and standards of workmanship than ever before.

3. The number of mechanics **grows less each year**—the demand for them greater.

One might enlarge on the conditions as they exist as set out in these three items; but, as there can be no dispute as to their accuracy, we will get on to the real question.

How Can This Condition Be Remedied

During the past two years many plans have been put forward and many conditions blamed for the trouble. You will hear men claim that organized labor is responsible for the condition, and that the open shop is the only remedy. Others will shake an accusing finger at the government and blame the immigration restrictions for the condition and so on, but to my mind, these criticisms are not sound and they certainly offer no remedy. This question has come up with increasing frequency during the past eighteen months, and some real hard thinking has been done to try and work a way out. There is not the shadow of a doubt that, unless a solution presents itself, building operations in this country and in the United States will be seriously interfered with during the coming year and the years to follow, and costs will soar again through unreasonably high wages and that indifference to production that invariably accompanies a labor shortage.

There is only one sound remedy. Apprenticeship of boys in large numbers with proper facilities provided for a real old-fashioned training. No one can dispute this. Immigration to this country of trained mechanics is not the remedy we want. It is not even economic to be allowing such a large portion of our Canadian boys to grow up untrained, filling the ranks of the unemployed, when there is such a crying demand for skilled men.

Apprenticeship of our Canadian boys is absolutely what is wanted. I am quite aware that I am only stating what everybody knows and has known for some time. I am not helping the situation any by proving it either. What you want to know and I want to know is: How are you going to get apprentices; how are you going to hold them if you do get them, or how are they going to hold to you as the case may be, and how are you going to train them?

Look this fact in the face—every builder employer realizes the urgency of training apprentices. Labor organizations have not interfered; I think their general attitude is favorable. Yet, in spite of these two facts, almost nothing is being done.

No Effort to Train Apprentices

There are cities in Ontario where not a single apprentice is being trained. In Toronto a survey of the building situation in 1921 made by Mr. Clapperton and presented to the Provincial Builders and Supply Association on behalf of the Kiwanis Club in connection with their campaign for helping the under-privileged boys show that only one boy was being trained in Toronto to eight that should have been. A canvas of the situation in all cities and towns of Ontario is being made, and though not complete, clearly indicates that little or nothing is being done through apprenticeship to help out the situation.

If one could place one's finger on the real cause, the remedy might possibly be found.

The Association of Canadian Building and Construction Industries have put in some work on the question during the past year, and have had a committee working on it. It has been a subject of special study at every convention, both Canadian and provincial during the past three years. The writer has an intimate knowledge of all the deliberations and findings and recommendations of these bodies, and would ask the reader to believe that the causes that the present conditions are attributed to and the remedy later suggested are not an impulsive theory. What follows has been well considered. I believe I am right as to the cause of the trouble, and I am confident that if the remedy suggested is endorsed and adopted conditions will readjust themselves in a surprisingly short space of time.

The Cause of the Trouble

Likely apprentices are not available. This is due to two things. In the first place, for many years past the percentage of young men going up through the higher schools has been increasing, seriously cutting down the number of what might be called potential mechanics, for, as we well know, a boy who has gone to school until he is seventeen or eighteen years of age is above such things as manual labor, and is not interested in learning a trade. In other words, to put it bluntly, there is too much education. I am not saying that it is not a good thing, but there is no doubt at all that you cannot have boys going to college and have bricklayers, carpenters, etc., also.

Now, the second trouble is, that with a smaller field to work in, that is, fewer prospective apprentices, we are failing to interest even a small percentage in the learning of a trade. With so many other vocations and lines of work open to him, with conditions so much easier and pay so much better, one cannot blame a boy for declining to be interested in the long period of probation of training of three or four years, which we call the apprenticeship period. It is, at best, hard work and poor pay, but what makes it far worse is that under the present conditions the apprentice is only trained during the busy season at the trade he desires to learn, and in the fall of the year is either laid off, or is employed as a laborer during the winter and early spring, during which time he loses much of what he had learned in the summer. In the case where a boy is laid off, which is usually the case, the parents are not in a position to support a boy of that age for four or five months, and the usual result is that he drifts into other employment. The employer, thus, has wasted his money and the boy has wasted his time, and other boys and parents of boys are discouraged in making further attempts.

In my own case, we have at the present time three bricklayer apprentices and two carpenter apprentices, and by Christmas we will not be able to keep them on any longer, our work being pretty well cleaned up for the year. Under present conditions we will have to choose between laying these boys off or paying them until spring for doing miscellaneous work that is of no benefit in their trade training. This problem is due directly to the seasonable nature of the industry.

Present System Needs to be Replaced

The Apprenticeship system of today is wrong; it is in the discard now. Something different and more attractive to meet modern requirements so far as these young men are concerned must be set up in its place.

It should not be the task of a few public-spirited men or men who see the extreme conditions we are drifting into so clearly to train the few boys that are available for the benefit of other employers. All employers should carry the burden equally, just as they do their workmen's compensation.

It should not be the case that a boy should be laid off in the fall or early winter, neither should he be kept on at work that is of no value to him at all in the learning of his trade. On the contrary, he should get his training all the time. When so many other easy occupations at good pay are open to the enterprising youth of seventeen and eighteen, the four year and three year terms of apprenticeship are unreasonable. If the boy got one hundred per cent training in his trade instead of about fifty per cent, as is now the case, the apprenticeship period should be and could be cut in half.

At the present time the technical schools are doing nothing whatever in the way of practical training for building mechanics. From inquiries which I have made, these schools are being used pretty largely for the sole purpose of allowing boys and girls between the ages of fourteen and sixteen years to go to work and fill in their four hundred hours of schooling called for under the Adolescent Act. In the Hamilton technical school there is only one trade that anything is being done with, and that is the printing trade, where an arrangement exists between the Typographical Union and the Technical School for a certain amount of education in the apprenticeship work of boys learning the printing trade.

What is wanted is constant work at one trade—for the bricklayer apprentice, for instance,—building walls of brick and tile and pulling it down and doing it over and over and over under practical mechanics until he acquires the dexterity that production demands and the skill to do it properly. But even if the technical schools could be made into the very thing we want over night, they would still fail to offer relief because of the fact that the boy earns nothing whilst he is there.

Here then is what is required:—

1. Make apprenticeship attractive. Shorten the apprenticeship period to a point where trade tests will give the boy his journeyman's card.
2. Pay the boy every working day all the year around. Have him out on public work whilst it is available and in the trade school under practical journeymen when it is not.
3. Make the trade at large pay the bill, with Government assistance.

"Sounds all very well but it's easy enough to talk, it would never work out." There are few that read this that will not quickly consider it a moment and pass it up with this comment. But let us consider for a moment. It isn't very many years ago that we all carried our own workmen's compensation insurance. We either carried the risk ourselves, or we went to an insurance company. Many accidents occurred where the losses were so great as to put the employer out of business. Yet it was not his fault. There were lots of cases where the employer was not worth the money required for compensation. It was not the men's fault, either. It was the nature of the business. In spite of all precautions accidents happened here and there and everywhere. The provincial government rightly decided that here was something that in justice to all concerned should be borne by the trade at large. The Workmen's Compensation Board is an accomplished fact and there is no finer institution in our business to-day than it is.

$150,000 a Year for Five Years

The amount of money required for this apprenticeship work compared to our Workmen's compensation would be a small fraction. If the sum of $150,000 was made available each year for, say, five years and the burden distributed equally between the employers and the two governments the additional rate paid in, either to the Workmen's Compensation Board for our particular class, if it were practical for that Board to handle it, or a separate board, would be a hardship to no one. I think, since the public at large benefit directly from the results; and since it would only bring to a more practical and complete termination the work the Governments are already spending so much money on through the establishment and carrying on of technical schools, that the governments should be ready and willing to lend their aid.

The work would necessarily have to be confined to those centres where Technical Schools are established, but the employers as a whole for the province should pay. The reasons for this are obvious to any one who has had to do any construction work in the smaller cities or towns. Their mechanics have left, they are found in the cities attracted by the large wages paid.

To my mind we have all the essentials at hand for a successful solution of this problem. Bring them together and teach our own boys a trade—take them out of the ranks of the unskilled and unemployed on the one hand, and put them in the ranks of the disappearing skilled mechanics on the other.

The Effect of Industrial Wastes in Sewers

Wastes from Manufacturing Processes Are More Widely Prevalent in Sewage than is Generally Recognized and Many of Them Are Very Destructive—Facilities for Cleaning Sewers

By **A. G. DALZELL, M. E. I. C.**

There are two important points that have to be considered in dealing with industrial wastes in sewage; the action of the wastes on the sewers and sewage in the sewer system itself, and the effect on the sewage at the disposal plant or outfall. In England some of the towns and cities have secured special legislation which enables them to decide whether they shall insist on the manufacturer giving some preliminary treatment to his industrial waste before discharging it into the sewer, or whether the municipal authority will take the responsibility of conveying that waste to the disposal plant, and make a charge for the extra cost of treatment that the special waste involves. A wrong conception sometimes arises as to what passes through a sewer system because the analysis of sewage is most frequently made at the disposal plant. As an example, the sewage of Lawrence Mass., has been largely employed by the Massachusetts State Board of Health in their experimental work which has been given much publicity. Lawrence is a very densely populated industrial city but the sewage used at the experimental station was taken from a trunk sewer at a point above the entrance of the mill wastes, so that it is strictly domestic sewage and the analysis must be judged accordingly.

The engineer and the chemist at the disposal plant are, of course, solely interested in the composition of sewage as it reaches the plant. That character varies from day to day and from hour to hour, but the sewage at the outfall of an industrial city is probably the weakest sewage in the system. At that point it consists of a combination of household and industrial wastes with a very large admixture of underground, surface and rain water. The construction engineer must, however, remember that industrial wastes sometimes contribute nearly the whole flow through long sections of the sewer system, and the action of the same on the materials that enter into the construction of sewers must not be underestimated.

There is an increasing tendency for manufacturing and industrial concerns to locate in suburban areas or just outside municipal boundaries. In some instances sewers are extended solely to serve these industries, and in other conditions surcharged with industrial wastes. In both cases the effect of these industrial wastes on the sewers is more severe than when industrial establishments are discharging their wastes into larger down-town sewers carrying a greater volume of water.

It is not always realized how extensive in the present day is the use of chemical agents in industries that are not classed as chemical but as mechanical. Especially is this the case in the industries that centre around the manufacture of the automoblie and its accessories. It has been stated that a very good index of the degree of industrial development in any community can be obtained if the amount of sulphuric acid consumed can be secured. The extent to which this chemical agent in one form or another is used can be gauged from the statement that whereas in 1913 the consumption in the United States was about 3 3/4 million tons, it is at the present time about 7 1/2 million tons per annum. Whilst considerable quantities are used in chemical industries there is an enormous consumption in many mechanical industries where the material is used for pickling purposes to clear metals from mill scale and to prepare the same for plating and polishing. The strength of the acid used in this way may run from one to 12 per cent and it is inevitable that some of it eventually finds its way into the sewers.

In other industries not classed as chemical industries, chemical agents are often extensively used. In rubber industries caustic soda and sulphuric acid are used in electrotyping and electroplating sulphuric acid is used, in lithographing nitric acid and photopraphic engraving acetic acid and though solutions are often considered as weak when compared with the standard strength of the respective acids, yet their action on metals is severe, and it is generally necessary even within buildings and on vertical stacks to replace metal pipe and fittings with vitrified clay pipe.

Similar conditions have been found in garages and battery stations where acids are often spilt into sewers. It is estimated that in the city of Chicago 110,000 gallons of acid reach the sewers from this source alone, perhaps with little effect on the main sewers or the sewage, but with well-known and disastrous effects on sewer connections which are not immune to acid action. It is well-known to those who use sulphuric acid that it can be safely stored in iron containers when the strength is above 60 degrees Baume but that when diluted and weak its corrosive effects are very severe and the destructive action of what are often considered weak acids has been noted on concrete as well as on metal.

In this connection it is reported that at Port Collins, Colorado, a law has been passed prohibiting persons using concrete roads as an avenue of travel for the conveying of beet pulp for the reason that the drippings injure the pavement. A similar case is reported at Utah (See Engineering News Record, Vol. 84 page 338), and though repairs were made by tar patches it is stated that the disintegration did not seem to cease.

Many Industrial Wastes are Very Destructive

The action of alkaline ground waters on concrete structures is now well understood, and it has been established that concrete of the very best quality can be attacked by such ground waters. Many industries discharge alkaline wastes as strong as these natural ground waters. When discharged into sewers with a large flow the action is neutralized but may be severe on sewers serving only industrial establishments. Ice Cream factories discharged large quantities of alkaline waste and creameries both acid and alkaline waste waters. In these industries also there is now used large quantities of carbonated water and this has an injurious action on any materials with a lime content. It must likewise be remembered that from creameries and other similar establishments large quantities of very hot water are discharged. Most municipalities have regulations prohibiting the blowing off of boilers and the discharge of water at high temperatures into sewers, but such regulations are very difficult to enforce. One case came under the writer's observation when as a result of a sewer connection from a creamery being repaird a workman was fatally scalded and evidence submitted at the inquest showed that the discharge of water at practically boiling point was of daily occurrence.

Solid Wastes That Clog up the Sewers

There are certain industries which have a tendency to discharge improper solid or semi-solid wastes into the sewers. When a new industry is started in a municipality there is always the temptation to dispense with settling tanks or screens necessary to remove solid matters from the waste discharged into sewers. Instances of blockage of main sewers arising from such disposal of waste that have come under the writer's own observation were a cider factory discharging apple pulp,, a canning factory which deposited tons of tomato pulp into a sewer, a soap factory which through failure of a valve discharged a large quantity of soap into a sewer where it solidified and could only be removed by taking up the whole of a city block of sewer, a gas plant which allowed carbide waste to run into a sewer forming a very serious obstruction, and a packing plant discharging grease, which was also very difficult to remove.

Grease from packing establishments and from large restaurants and hotels is often a serious trouble in a sewer system and a severe handicap to effective treatment at a disposal plant. The ordinary grease trap is often quite inadequate. The greatest trouble generally arises from the medium size establishment as the large packing houses and the largest hotels generally make adequate provision for grease recovery. Grease will be found to be especially troublesome if discharged into sewers which are surcharged either with the inflow of tidal or river water or through being inadequate in size. In such cases the grease is rapidly congealed and coats all around the pipe greatly reducing the carrying capacity of the sewer and causing frequent obstructions. With a sewer at normal flow the grease is carried along and congeals in such thin films that it will scour off without much trouble.

In designing and constructing a sewer system the sewer engineer must take into consideration the unusual and unexpected things that happen and see that the sewers will stand the abuse that inevitably occurs. Accidents occur in industrial establishments, and there is an ever present temptation to get rid of objectionable and even dangerous waste by the quickest method and if it can be got down the sewer it generally goes that way. When a fire occurs sewers are often overcharged and sometimes chocked with the debris. After a fire ruined buildings are exposed to the weather for long periods waiting insurance adjustment or decisions about rebuilding, and materials that would not usually find their way into a sewer system drain there. An instance that came under the writer's notice was a large paint warehouse destroyed by fire in severe winter weather and before the debris could be cleared away large quantities of oils, varnish and various chemicals found their way into the sewers.

Facilities for Cleaning

Sewers built in a proper way of the right materials at an adequate grade should be self-cleansing, but in industrial areas may require occasional flushing. Larger sewers on flat grades sometimes require cleaning by manual labor. Such work is greatly facilitated by building manholes of adequate size. At one time the Local Government Board of Great Britain insisted on the bottom chamber being six feet in length. This may appear to be excessive but every manhole ought to be of sufficient size to allow two men to stand in the bottom, as this is often necessary for cleaning purposes and in the event of a sewer workman being overcome by gas in a sewer a very small manhole makes the work of recovery very difficult. In very large sewers it will be found to be a great convenience to have some large manholes with side entrances through which barrows and materials can be taken into the sewers and work done without causing any obstruction on the streets.

The treatment of industrial waste at the disposal plant is often a very serious problem and complicates the question of sewage disposal. In a few instances the trade waste has been turned to good account and made to assist in the work of purification but this is exceptional and in many other cases manufacturers are compelled to give their waste some preliminary treatment before discharging into the sewers. Where such preliminary treatment is insisted upon the service connection should be provided with an inspection manhole, to enable tests to be made of the discharged effluent; otherwise it is difficult to know whether all conditions are being fulfilled. Year by year chemistry finds a wider application in industry and the construction engineer and the engineer in charge of sewer disposal must be prepared to meet new conditions as they may arise.

Canada's Fuel Problem

A Discussion of the Question by Members of the Ottawa Branch of the Engineering Institute of Canada

"When the sum total of heat energy represented in Canada's resources of solid fuels—coals of all kinds peat and wood, natural gas, crude oil, and water powers, is considered, it will be seen that the country possesses sufficient energy for heat and power to answer requirements at the present rate of use, for a period considerably over fifty thousand years." So declared Mr. B. F. Haanel, B.Sc., M.E.I.C., engineer of the mines branch, department of mines, at the meeting in the assembly hall of the Victoria Memorial Museum on Dec. 7, called by the Engineering Institute of Canada to discuss "The Fuel Situation in Canada." Mr. Haanel, who took as his part of the subject, "Means and Ways of its Improvement," was followed by Mr. John Murphy, electrical engineer to the department of railways and canals and the railway commission. His subject was "Electric Energy and Its Use in Heating." Mr. George A. Mountain, of the railway commission, spoke briefly on "The Transportation of Fuel in Bulk." Dr. Charles Camsell, deputy minister of the department of mines, presided and introduced the speakers with a few remarks on the seriousness of the fuel situation.

Problem of Distribution

Dr. Camsell, in introducing the speakers, pointed out that fuel problems are the result of the irregular distribution of the coal resources of the world. There were enormous resources of coal within Canada's borders, more than any country in the world, with the possible exception of the United States and China, but Canada had a big problem in distributing this coal to its centres of population. The coal, he said, was in the extreme west or east, while the most populous provinces, Ontario and Quebec, were without a commercial supply.

It was usual, he said, to look upon the problem as a contest between the American and Canadian coal fields. The contest was still on, and apart from the desirability, from the national point of view, of supplying our own country with our own fuels, there was always the danger from one cause or another of United States coals not being supplied to Ontario and Quebec in sufficient quantities, particularly in the domestic market.

For the purpose of studying these problems and advising on the solution to meet them, the minister of mines. Hon. Charles Stewart, had appointed a committee, of which, the speaker had the honor of being chairman. In order, he said that the committee might have the benefit of the advice and suggestions of those interested the Ottawa Branch of the Engineering Institute of Canada had called the meeting.

Canada's Fuel Resources

Mr. Haanel, in opening, reviewed the fuel resources of the country. He said that the fuel resources of Canada, comprised the coals of British Columbia, Alberta and Saskatchewan in the west, the coal deposits of Nova Scotia and New Brunswick in the east, the large areas overlaid by peat in all parts of the Dominion, the oil and natural gas fields of Ontario, New Brunswick and Alberta, and the standing forests. If, he said, by fuel resources, is meant all sources of heat and energy, then he would add the enormous potential energy represented in the developed and undeveloped water powers distributed throughout the country. Taking these total resources all together, here was sufficient energy for heat and power to answer the requirements at the present rate of use for a period considerably over fifty thousand years. In fact, the coal resources alone, he said, would last at the present rate, for well over thirty thousand years.

The geographical location of these resources, said the speaker, was the explanation of the discussion of fuel problems which are perplexing so many. The wide stretch in the centre of Canada was practically without coal, but had large deposits of peat. Ontario and Quebec also had large resources in water powers. This portion of the country was the most thickly populated.

Backbone of Civilization

"Mechanical power and heat," he said, "more than any other agencies, are the backbone of civilization. An interruption of a continuous supply will throw multitudes out of work, and if of continued duration, make life itself in this northern climate impossible."

If homes, he said, could not be heated, industries would not matter. For this reason heating should be placed ahead of power requisitions.

A peculiar aspect of the country's problem was the two great different problems in the west and east. In the west, there was an overproduction of coals of all kinds, while in the east a real difficulty was experienced in meeting the requirements of markets which might easily be created. This situation in the west was very further aggravated by the substitution of cheap oils for purposes for which British Columbia coals were formerly used. The speaker here remarked that patriotism was no panacea for the evil. If, he said, oil could be imported into Canada at a price which permitted it to be used as a fuel at a lower cost per heat unit than coal, then it was economically right to import and use it.

Freight Rates a Handicap

Prohibitive freight rates, Mr. Haanel said, were the reason why the question could not be solved by sending some of the surplus from the west to Ontario and Quebec, where it was needed. The freight rates were due only to the 2,000 mile haul, but to the impossibility of balancing freights. Coal cars coming from the west would have to return empty. Even if the freight rates were cut in half, it would be a question whether the western dealers could seriously compete with the American collieries. The speaker noted that Manitoba was rapidly becoming independent of American coals through the increasing use of Alberta coals for both industrial and domestic purposes. The same would apply to Saskatchewan.

The area covered by Ontario and Quebec, Mr. Haanel termed the "Acute Fuel Area." Practically all the coal used in these two provinces was imported from the United States. A small part of Quebec's requirements of soft or bituminous coals was received from Nova Scotia; but outside of that, all the coal used by both provinces was imported from the States.

30 Million Tons Needed

In seeking to solve the problem, Mr. Haanel said that the total requirements of Canada for a year was about 30,000,000 tons, a little less than four tons per capita. Of this, he said, nearly 60 per cent was imported from the United States. Anthracite coal, the annual imports of which amounted to about 5,000,000 tons, constituted a large percentage not only of the total coal imported, but of the total fuel consumption of Canada. It was, he said, this quantity of coal with which the public was most concerned since it was almost entirely for heating homes and in some instances public buildings. Some suggestions made for the solution of the difficulty were; the substitution of western coals for the hard and soft coals required for domestic heating and industrial purposes; the substitution of fuel oil for domestic heating, and the use of hydro-electric energy for domestic heating.

High Cost of Haulage

These suggestions the speaker scouted in a few words; the first, that of substituting western coals for the imported ones, he said, was impracticable because they could not be purchased at points east of Port Arthur on account of the exceedingly high cost of haulage. The freight rate, he said, was absolutely prohibitive even if the railways reduce it to the irreduceable minimum.

Use of Fuel Oils

The second, that of using fuel oils, he said, should not be relied on because the highest authorities had stated that the anthracite coal deposits of Pennsylvania would be depleted within 80 years. If so much alarm was manifested by the reports regarding the depletion of coal supplies, what should the state of mind of Canadians be concerning fuel oils, of which 98 per cent of all Canada's requirements was imported —practically all from the United States—and from a source, the life of which is estimated at only 25 years. This source, it might well be imagined, might be cut off at any minute. What then of all the money invested in oil burning heaters? The third, that of using hydro electric energy was not, the sqeaker said, impracticable in the same sense because the supply was practically continuous and inexhaustible. Nevertheless, he said, hydro electric energy was a high grade of energy—being the conversion of a lower form of energy into a higher and much more valuable form. Hence this form of energy, whether developed from falling water or other means would cost more than heat generated through the burning of coal—at least throughout the thickly populated districts of Canada. Moreover, said the speaker, electrical energy should be reserved to serve the best interests of all concerned —for those industries to which its use was indispensable.

Use of Our Own Fuels

The solution Mr. Haanel put forward, as being the only one practical was the utilization of Canada's own high grade and low grade fuels and the use of imported fuels in the mose efficient manner possible.

The Canadian fuels to be used, he said to reduce the quantities of imported domestic and industrial coal, were the bituminous coals of Nova Scotia, the numerous peat bogs of the provinces of Quebec and Ontario, and the standing forests. The imports could be still further reduced, as they had in the past, by the further development of the water powers in Ontario and Quebec.

Nova Scotia, he said, could increase her exports of coal to Quebec to a maximum of one and a half to two millions of tons. The coking of a large part of this by a plant situated at Montreal and the intensive development of peat bogs favorably situated with respect to short rail hauls to points of large consumption would very materially reduce the annual requirements for anthracite coal.

Ontario's Requirements

Ontario, on the other hand, while not buying any anthracite from the United States, would have to buy bituminous coal. The supply of this in United States was quite large and might be considered far from exhaustion. The coking of this coal in a plant situated at Toronto, and the intensive development of the peat bogs in Ontario as was suggested for Quebec, would, he thought, eventually eliminate the necessity for Ontario buying American anthracite.

Central heating plants, he maintained, should be established at strategic points in the large centres of population and hydro electric energy be substituted for generated energy wherever possible. This, he said, should result in materially reducing the annual coal bill of Ontario.

In conclusion Mr. Haanel said that no master fuel policy would suit every individual in Canada, and that no suggestions, however valuable they might be, would be of the slightest use without the whole-hearted support of the people of Canada. The people should not forget the lessons of 1918 and 1922. There might be a lull in the storm, but it would surely pass this way again and with increased fury.

Electric Heating

Mr. Murphy, discussed electric heating from three points of view: that of the nation, the individual and the power company.

From the viewpoint of the individual, electric heating was desirable for convenience, cleanliness and low fire risk. Installation cost about the same as a furnace and hot water system. But with electric heating there were no ashes, no furnace man, and no yearly worry about a fuel supply. When heat was required, turn on the switch. The consumer would not believe that the system was economically impossible for the very good reason that he did not wish to do so.

Views of Power Company

The power company viewed things differently. It was easy to see that electricity generated by steam or other means than water power was not suitable for use in heating on account of the high cost. The heat developed by the electricity is only about four per cent of that generated under the boilers in the first place.

The capacity, he said, of a hydro electric plant depends on the flow of water through the different seasons of the year, and in the winter this is usually at a minimum. The surplus water in the summer constituted a loss, and it is the company's need to have their power so contracted for, that it will all be used at all times. The tariff, therefore is made so that the consumer contracting for power during the whole year, gets the cheapest rate. The next lowest is the consumer who uses power for cooking stoves, irons, toasters, vacuum cleaners, sewing machines and the large number of other devices used. The next rate is charged to users of lights, who use them more in the winter than in the summer. The highest charge is made to users of electric heating who do not require any in the summer but put a big load on the plant in the winter time.

Electric Heating a Crime

"Heating by electricity is a crime," were the words used by Mr. Murphy. In the first place, he said if 100,000 horse power was developed solely for the purpose of heating, it would not heat one fifth of the houses in Ottawa. In Italy it is an indictible offence to sell an electric heater. The same amount of heat requirel to heat a house would operate 100 sewing machines, would cut 6,000 cords of wood, would pump millions of gallons of water every year, or transport twenty people 200 miles a day.

National Point of View

The national point of view, said Mr. Murphy, and illustrated the point with a chart showing the relative value of electricity and the amount of energy wasted in its generation, was that to degrade the electricity to use it for heating was like making kitchen utensils out of gold. They would look very nice, but there would not be enough gold. The conservation of energy electrical for industrial expansion in its many branches was a matter of national interest.

Transportation Problem

Mr. George A. Mountain, in a brief speech reviewed the fuel transportation problem. He took the Atlantic coast as a starting point. In Nova Scotia, he said, the Sydney, the Pictou and Cumberland districts supplied domestic and steam coal to the provinces of Nova Scotia, New Brunswick and Quebec, and a small quantity to the easterly portion of Ontario.

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Ventilation Principles and Practice

The Importance of Ventilation and the Systems that Are Applicable to Various Types of Buildings—Standard Requirements—Relationship of Heating and Ventilation

Continued from Last Issue

The designing of a ventilating installation, whilst being governed by general principles, is also, one might say, controlled by the important question, "Is it an existing building or is it one proposed or in course of erection?" To take the latter first we have for guidance general principles and past experience upon which to design our installation, and then there remains collaboration between ventilating contractor, architect, and builder.

To commence with we have presumably a very complete set of building plans, showing clearly the rooms or various parts of the building to be dealt with and from which the cubic contents may be obtained. In addition, one should obtain, if at all possible, particulars of the probable use of each part of the building, and, if only an approximation, the number of persons likely to be accommodated. This enables a comparison to be made between volume based upon a certain number of changes per hour and volume based upon a certain quantity of air per person per hour.

Volumes giving less than two changes per hour are not advisable owing to the difficulty of obtaining effective distribution of the fresh air. At the same time, the volume may be kept as low as possible commensurate with providing good and efficient ventilation as a sure means of keeping capital outlay and running costs down to the minimum. Another point of importance is that the space required to accommodate the plant is smaller.

In dealing with new buildings—that is, buildings in course of erection—greater latitude is generally available, and within reasonable limits one can state space required, position, and other important factors, and arrangements are made accordingly. There is, however, occasionally a tendency to sacrifice the efficiency of a ventilating installation to aesthetic requirements or to make the provision of other requirements more easy. These departures from original lay-out are to be deprecated if it is at all possible to avoid them, for they will invariably lead to trouble and need for adjustment after the plant is started up. To remedy defects from such causes can be, and has been, an expensive matter.

Usually with new buildings the space available for the plant is stated, and the chief matter upon which negotiations with those concerned proceed is the run or lay-out of the ducts, or flues, for the conveyance of the air to the various points of distribution. Endeavors to introduce obstructions or right-angle bends in ducts because "they look better" should be very strongly resisted, for it is impossible to produce an efficient installation by so doing, and it must be remembered that every such obstruction or bend adds to the running costs.

Existing Buildings

In dealing with existing buildings it can be stated that generally the designing of an installation is in some respects simpler, although the actual carrying out of the work will be more difficult than with new buildings. No matter how good the drawings of a building may be, the design of a ventilation installation for an existing building should never be completed without close inspection of all parts during the time the building is actually in use. This is a far better guide to the requirements than merely figuring upon cubic contents or number of persons, although it is not, of course, suggested that these can be ignored.

Having inspected the building and obtained the information necessary it is possible to approximate the volume per minute to be introduced, which at once enables one to state approximately the space required for the accommodation of the necessary plant. From this also is obtained the approximate sizes of the various main and branch ducts. Then, in considering where the plant may be placed, due regard may at the same time be given to the possibility or otherwise of getting the ducts in to communicate between the plant and the points of distribution. Consideration of the plant position cannot usefully be given without conjointly considering the run of the ducts. It will generally be found to save time and trouble if all parts comprising the installation are approximated and the whole job mapped out in rough outline before finally setting the complete job out in detail.

Design of Distribution Ducts

The designing and proportioning of the air distribution ducts has a very important bearing on a complete installation, and this may be summarised as follows:—

(1) Efficiency of installation in regard to ventilation as distinct from power consumption.

(2) Capital outlay.

(3) Silent operation.

(4) Cost of running the installation.

Under the first heading great care should be exercised to see that the ducts are constructed smoothly inside without obstruction to cause eddy currents of the air and so loss of effective pressure. The ducts must be correctly proportioned so that each branch will carry the requisite amount of air to the various points of distribution. All bends or changes in direction to the air flow should be made easy and gradual. Where the path of the air has to be turned through an angle of 90 degrees, the back or outside of the bend must be curved and the inside of the bend must be curved or throated, such throat to have a radius not less than equal to the breadth of the duct. This applies whether the duct is circular, square, or rectangular. All joints in ducts should be close-fitting and made air-tight throughout the system. Ducts should always be constructed of galvanised sheet iron unless it is desired to adopt the more expensive method of galvanising after manufacture. Black or unprotected sheet iron or steel should never be used in a ventilating job, because in course of time the surface becomes oxidised and flakes off, with the result that the flakes are distributed about the system, which might be very objectionable, as, for example, if the air were being delivered to an hotel dining room or restaurant.

Capital Outlay

As will be apparent, the smaller the ducts are made the lower the capital outlay, not only owing to the lower cost of the ducts themselves, but also by virtue of the fact that they will be simpler to install. Particularly does the latter remark apply to existing buildings. Nevertheless, with a given building and necessary volume, the duct dimensions cannot economically be reduced below certain limits because of the effect upon silent running and power consumed to run the plant. In installations for factories and works buildings silent operation is not generally a matter of importance, and in such cases the velocity of the air can be higher than in office and public buildings.

The frictional resistance of a duct varies as the square of the velocity. In other words, if we assume a duct that will carry a quantity of air at 1,000 lineal ft. per minute velocity for a loss of 1 in. w.g., and compare this with a duct having half the cross sectional area and carrying the same volume, thereby involving a velocity of 2,000 lineal ft. per minute, then the loss would be 4 in. w.g. With a given volume the power varies directly as the water gauge, so that in the cases cited it would take four times the power to get the same volume through the smaller pipe as compared with the larger. It will be seen that consideration of velocity of air movement throughout the system is essential.

For best results in office and public buildings the figures set out hereunder may be regarded as a useful guide, and should circumstances make it impossible to do otherwise the higher figures should never be exceeded.

	Velocity of air Lineal ft. per min.
In intake from fresh air to primary or pre-heater	1,000
Through primary heater	1,000–1,600
Through main heating battery	1,000–1,600
Through main air ducts	1,000–1,500
Through outlets (depending on height and width of room)	200–400
Through exhaust ducts	1,000

In factory installations a velocity of 2,400 to 2,600 lineal ft. per minute is used for main ducts. It will be appreciated that it frequently happens that for factory buildings the capital cost can become of greater consideration than in the case of office or public buildings, because factory buildings are so frequently on specially cheap rates for power and it becomes good policy to reduce capital cost in spite of increased power consumption. Smaller ducts with air at consequent higher velocity not only reduces the cost of the ducts but also directly affects the cost of the fan and motor to drive it. For a given volume, the higher the resistance against which the fan has to deliver this volume the smaller the fan required. Also, it operates at a greater speed or revolutions per minute, and this affects the cost of the motor when direct-coupled fan and motor are used.

The following figures taken from well-known makers' list will illustrate the point clearly:—

	R. P. M.	Volume.	W. G.	B. H. P.
35 in. dia. fan	400	19,000	1¼ in.	6½
30 in. dia. fan	600	19,000	2 in.	11

It will be found that a motor for the above powers at their respective speeds may be obtained from the same size or frame of machine, but there will be a reduction in the cost of the combined set of fan and motor in the second example compared with the first. As previously mentioned, if silent operation of the system is important then high velocities of air movement must not be used, and as a useful guide for silent operation the velocity figures given in the table may be followed.

Heating and Selection of Heaters

A ventilation installation in a factory building is often used to advantage as a heating installation in the cold weather by introducing warmer air. This is termed indirect heating. In office and public buildings this is also done, but not so frequently. In this case the building would be heated by a method independent of the ventilation, such as hot-water radiators, and the air supplied for ventilation is slightly warmed, or "tempered" as it is termed.

When in cold weather the air of a ventilation installation is to be warmed, means to obviate "dry heat" should be taken. If the installation comprises an air washer or wet filter this provides a ready means to achieve the object. In this case the air is warmed sufficiently by the pre-heater, so that when the air comes into contact with the water, evaporation of water takes place and the humidity of the air is thereby increased. The air then passes through another or final heater (or "re-heater," as it is sometimes called) and raised to the desired temperature. This final temperature is governed by the object to be achieved, that is, whether it has merely to be "tempered" or whether it has to be raised sufficiently in temperature to heat the building also.

For a heating medium we are really limited to hot water or steam—preferably of low pressure—circulated through radiators, of which there are a number of well-known designs eminently suited to the purpose. It is undesirable to have the temperature of the heating surface in excess of about 250 deg. F., as higher temperatures couse carbonization of dust particles and organic matter in the air, and unpleasant odor is often imparted to the air in consequence.

The operation of a hot-water system for the heaters does not require the skilled attention desirable or necessary with steam, and as a consequence under certain circumstances it has an advantage, but, on the other hand, a much larger heating surface has to be provided when hot water is used compared with steam. The square feet of heating surface with steam may be reckoned as roughly one-half to two-thirds of that necessary for hot water to produce the same temperature rise on a given volume of air. This is effected by the higher temperature difference between the steam inside the radiators and the air external thereto, and also the latent heat of steam given up when the change of state takes place from steam to water; in other words, when condensation takes place.

The Design of Heaters

In designing heaters, two things have to be considered: (1) Space required, and (2) resistance to flow of air through the heater. Heaters are arranged in stacks, and the number of stacks necessary to produce a desired temperature rise will depend upon the velocity of air through the heater at which it is desired to operate. Hereunder is given a table to illustrate the variations which may be made in the arrangement of a heater to achieve the same result.

Steam 5 lb. per square inch gauge pressure.
Air entering heater at 30 deg. F. in all cases.

No. of Stacks	Velocity of air through heater.	Final temp. degs. Fahr.	Condensation of steam per sq. ft. lbs.	No. of sections per stack for 10,000 cub. ft. per min.	Total sq. ft. of heating surface.
1	200	81	.65	80	860.
2	1,100	81	1.89	15	322.5
2	200	117	.56	80	1,720.
3	600	115	1.09	27	870.75
4	1,200	115	1.63	14	602.
5	1,800	115	1.96	9	483.75

The above table serves to illustrate the greater efficiency from the point of view of heat transfer when working at the higher velocities, and the consequent saving in radiation surface. On the other hand, the nicreased velocity of the air and necessary greater number of stacks increase the resistance to the flow of air through the heater, and causes greater power consumption by the fan. It must be remembered at all times that the resistance (and consequently the power required) varies as the square of the velocity. A single stack heater would seldom, if ever, be used for a greater temperature rise than 30 degrees because of its low efficiency if the air is passed through at a lower velocity for higher temperature rise. The second part of the above table particularly emphasizes the advantages of the higher velocity due to the much higher average condensation per square foot of surface. The average condensation is increased so much because of the big increase in the condensation obtained on the first stack, viz., the one which the air passes through first.

The following gives the condensation per square foot on the first stack relating to the six lines of the above table:—

1	.65
2	2.04
3	.65
4	1.39
5	2.17
6	2.54

It will be seen that a fairly wide variation is possible in a heating battery to obtain the same result, and therefore is of considerable assistance when there are limitations of space in which to put the plant.

Air Cleaning

For best ventilation it is desirable that means should be provided to cleanse the air of dust and other impurities before it is distributed about the building. Various means have from time to time been adopted to do this, and undoubtedly the best method is the type of air washer now in general use. This consists essentially of bringing the air into contact with a large volume of water, generally in a finely divided state. Wet surfaces are also provided over which the air is compelled to travel. There are a number of air washers on the market at the present time, all claiming to be equally efficient as filters. Generally the variance is in constructional details, and the choice of any particular washer really becomes a question of price and personal preference. Points to be looked for are robust construction and protection against rust and corrosion; effective spraying nozzles, and efficiency of the means to filter the water where it is recirculated by means of a pump.

Selection of Fans and Motors

The multiblade fan is undoubtedly the type of fan mostly in use at the present time on account of its higher efficiency and more silent operation. For economical reasons it should always be the aim to select a fan that will fulfil the required duty at, or very near, its rated capacity for highest efficiency. When silent operation is an important consideration, the installation should be so designed that the total resistance to the air is not more than 1 in. to 1¼ in. w.g., and the peripheral speed of the fan not much more than 3,000 lineal ft. per minute—preferably less. Fans should be carefully and properly balanced with moving parts of robust construction and bearings of ample length with good oiling surfaces. Fans may be arranged for direct coupling to motors, or they may be driven by belt. Where speed control is possible, this should be provided. When a direct current electric supply is available speed control is best obtained by "shunt control." In such cases the motor is primarily designed to run at the minimum speed of the range of speed specified, and by the operation of "shunt control" the speed of the motor is increased with practically no change in the efficiency of the machine. An alternative method is "series control," where the motor is designed for the maximum speed and the speed is reduced by insertion of resistance in the electric circuit. This method, however, is wasteful, and except in the case of small fans and motors should not be used.

For exhausting air the propeller type of fan is generally adopted, but they are only efficient when drawing direct from the room or building without the interposition of long lengths of duct. The propeller type of fan is unsuitable, and uneconomical for overcoming greater resistance than about ¼ in. w.g. Propeller fans may be arranged with direct coupled motor or for belt drive. Where direct coupling is used the motor is usually supported from the fan ring or frame, and the fan propeller is mounted direct on to the motor shaft.

Ozone

Before concluding, reference may be made to the increasing and beneficial use which is being made with ozone in ventilating installations. Ozone is a changed or endothermic form of oxygen. Oxygen exists in air everywhere, but ozone, owing to its greatly enhanced oxidising properties, is only found in the atmosphere where impurities do not exist and where nothing is causing pollution with consequent absorption of ozone.

Apparatus is manufactured for the production of pure ozone by electrical means and imparts an agreeable and refreshing odor to air and renders air healthful, minimising, if not destroying, the spread of certain diseases. Ozone has been proved to be of great value in destroying smells from the kitchen, smoking-rooms, public conveniences, and the like. It has also been used with marked effect in the destruction of smells created by manufacturing processes, but here greater concentration of ozone would generally be used than is ordinarily required for general ventilation.

We have previously referred to ventilation by recirculation, and in such systems the use of ozone has been found to have very considerable value. The cost of running an ozone-producing plant is only a very small fraction of the toal cost to run a complete ventilating plant. The use of ozone will often enable a better ventilation result to be obtained with a smaller volume of air than could be obtained with a larger volume without ozone.

It is hoped that the foregoing notes will be found of some little assistance to give guidance on general lines when questions of ventilation have to be con-

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What is the Significance of Road Tests?

The Gathering of Experimental Data Relating to Road Materials—Necessity for Taking Certain Factors into Consideration When Interpreting Results

By **F. N. JACKSON**

Before the American Society for Municipal Improvements

The art of testing road materials has by no means attained the perfection of an exact science. Some of the tests now in use were first proposed and adopted many years ago when the necessity for adequate preliminary research was not realized quite so much as it is to-day. The result is that certain tests have been firmly established by custom and long usage which are admittedly weak in some particulars. The so-called Deval abrasion test for rock and the "tensile strength ratio" determination for concrete sands are typical examples. Because these tests are not technically perfect, however, is no reason why they should not be used. They can be made to serve a very useful purpose, provided the engineer understands wherein the tests are weak and makes due allowance for his interpretation of the results.

The very rapid changes within the past few years in the design and types of pavements in use, caused by changes both in the volume and character of traffic, likewise continually call for modifications in testing methods to meet new conditions. As an illustration of this point, the cementation test for rock may be cited. This test was used quite extensively in the days of water-bound macadam road construction but is now practically obselete. The standardization of tests is at best a slow process and when one considers the frequency with which new conditions arise, it is not surprising that some of our methods of tests have failed to attain the perfection which certain critics seem to expect.

Availabilty of Material

Another point which is overlooked frequently in studying test data is the question of availability of material. Although this is a matter primarily for the specification writer, experience has shown that many specifications contain requirements which can not be met with any available material. It is well, therefore, that the engineer be familiar with the range in quality as shown by test results of all materials which could compete with those which he is examining.

Looking at the proposition from another angle, a third essential requirement is that he be familiar with service results obtained with materials similar to those in which he is interested. This particularly applies to such naturally occurring products as rock, sand, gravel, etc. The proper selection of such materials in any case can only be made by studying the test data in the light of all of the service indications which it is possible to obtain. Likewise, in the eamination of tests of manufactured materials such as Portland cement, paving brick, etc., it is desirable that the engineer know something of the previous service and characteristic weaknesses, if any, of the particular product he is investigating. For instance, he may know of a certain mill which may be grinding cement so as just to pass the specifications. He would naturally scrutinize results of fineness tests on this product more carefully than where he is reasonably sure from past experience that the mill is well within the limit.

It will be seen from the above that to pass judgment intelligently on the results of laboratory tests is not quite so simple as might be supposed. Summing up briefly, anyone who would make the best use of such information must know enough about the methods of tests employed to be able to apply reasonable tolerance, he must be familiar with the general character and range in quality of all available materials, and he should know something of the previous service rendered by similar materials in the type of construction involved.

A brief discussion of some of the more commonly used non-bituminous road materials along the lines suggested above follows:

Portland Cement

Portland cement is probably the most universally used of all of the manufactured materials employed in the construction of roads. There is hardly a street or highway of any kind built in which cement is not used, either in the base or surface course of the pavement or in the construction of drainage structures, curbs, etc. The present requirements of the Bureau of Public Roads specify that all cement used in Federal Aid construction must be tested regardless of the amount involved. Practically all portland cement is now manufactured under the specifications and is tested by the methods prescribed by the American Society for Testing Materials. Several years' experience in testing this material has convinced the writer that although these methods of tests are far from perfect they are sufficiently accurate when properly conducted to detect inferior cement. The words "properly conducted" are used advisedly because there are many laboratories which are unfortunately carrying on routine tests of cement in an incorrect manner. Throughout this paper, however, it will be assumed that the laboratory methods in use conform to the best practice, and that what variations in results are obtained are due rather to inaccuracies in the test itself than to carelessness or ignorance on the part of the laboratory. The present specification limits for portland cement have been set so low, particularly as regards tensile strength, that there should be no difficulty for any standard brand properly manufactured to meet the requirements. For this reason, the writer would be inclined to adhere rigidly to the present American Society for Testing Materials' requirements, except possibly in the case of the fineness test where a 1 per cent. tolerance is permissible to cover unavoidable variations in testing.

In this connection it is well in interpreting fineness test results to be sure that a standardized cement sieve was used. Cement No. 200-mesh sieves now on the market are apt to vary as much as 3 per cent. from the true value. All reports of fineness tests should indicate that the result has been corrected and should give the correction factor. The U.S. Bureau of Standards will standardize cement sieves for a nominal charge. Results of tests for time of set are usually well within specification limits. Due to the large personal equation involved in this test, no significance should be attached to variations within the limits. About the only value the test has is to detect a flash set. If a flash is reported, however, the cement should positively not be used until it has been thoroughly re-tested and found to be O.K. A word also about the soundness test may not be amiss. A mere report of unsoundness by the laboratory is not sufficient cause for rejection. Unsoundness is caused by the hydration of an excess of free lime which produces disintegration in the cement by reason of its increase in volume. If a cement showing such unsoundness is stored for a period of two or three weeks prior to use, the chances are that the lime will air slake and thus become inert. Cements therefore which are unsound when first tested should always be held for a sufficient period to allow this slaking to occur, after which they should be retested and if sound, accepted for use.

The strength and durability of concrete depends fully as much on the character of the aggregates used as on the quality of cement. For this reason a number of tests have been devised and requirements established for both fine and coarse aggregates for the various types of construction.

Fine Aggregates

Fine aggregates, that is, sand, stone screenings, or combinations thereof, are usually subjected in the laboratory to four routine tests: grading or mechanical analysis, silt content, mortar strength, and color test for organic impurities. This is, of course, in addition to tests of the concrete fabricated from the aggregates being investigated. A discussion of the significance of these laboratory tests as they apply to the use of sand for concrete road construction will serve to call attention to some points which are not always appreciated by engineers. The grading of the concrete sand is an important consideration apart from any other test. If the sand is too fine, a weak mortar and a low resistance to wear will be produced. If, on the other hand, it is too coarse, a harsh open mix difficult to work and with a consequent tendency towards the use of too much water will result. The average specification for sand controls the grading within safe limits. The trouble has been that many engineers look upon the test for mechanical analysis as secondary to the strength test and are inclined to waive the former if the strength be within the specification requirement. A knowledge of the relations existing between the various tests would show that many sands much too coarse for satisfactory use in concrete will show very high strength ratios. Results of the strength test under these conditions are very misleading, because of the natural assumption that the higher the strength the better the sand. The point to be emphasized here is that the strength test should only be considered in conjunction with the grading. If this is done, the strength of the sand for any given grading will be an indication of its quality. Thus, for a normally graded concrete sand; that is, one showing about 20 per cent. coarser than a No. 20 sieve, a strength ratio of 100 per cent., indicates satisfactory quality. A lower strength is an indication either of the presence of some deleterious substances such as organic matter or that the sand grains are of poor quality. An unusually high strength invariably indicates a very coarsely graded sand. The color test for organic impurities alone is only an indication of danger because there are substances found in concrete sands such as lignite, small particles of coal, etc., which show an unfavorable reaction and are still entirely harmless. If, however, the sand when normally graded shows low strength, the chances are that the substances causing the color are of a harmful nature. If, on the other hand, the normally graded sample shows a low strength and no organic impurities, the trouble is undoubtedly due to poor quality of grains. Tests for silt content are usually positive indications, especially if the determination has been made by weight. Presence of silt in any sand which is to be used in a concrete surface exposed to wear is of course undesirable for this fine material tends to work to the surface and greatly weaken it. The usual specification allows a limit of 3 per cent., and in concrete road construction it is seldom wise to exceed this limit. The term "silt" in this connection is used to cover only the material lost in the elutriation or washing test. It is usually composed of clay, loam or excessively fine sand, considerably finer than a No. 200 sieve. Ordinarily fine sand passing a 100-mesh sieve is not harmful in amounts less than 10 per cent. providing the silt content is low.

Coarse Aggregate

Stone, gravel or slag which is to be used in the construction of concrete pavements should, in addition to being structurally sound, posses sufficient resistance to wear to withstand the abrasive action of traffic. This is particularly true in the case of city streets which are subjected to an appreciable steel-tired traffic. The most commonly applied test for coarse aggregates is the Deval abrasion test. It was designed originally for use in testing macadam stone. The need for some form of test for quality of coarse aggregate led to its adoption for this purpose in spite of the fact that there are many engineers who believe that it was wrong in principle when used in this connection. The test can be applied either to stone, slag, or gravel. The methods of testing, however are somewhat different so that the results are not directly comparable. Opinion differs as to the proper test limits to apply when selecting aggregates for pavements. Many concrete roads constructed of stone with a percentage of wear as high as 6.5 or even 7.0 have given good service. As in the case of other materials, however, the best available aggregate should be used and it is for the purpose of comparing available materials that this is of particular value. Although as stated above there is no direct relation between the results of abrasion tests of stone, gravel and slag, numerous laboratory tests have shown that, in general, these materials when of approximately equal quality, will show results in the ratio of about 1:3:2. That is, gravel with a percentage of wear of 15 and slag with a percentage of wear of 10 will be of approximately the same quality as stone with a percentage of wear of 5. It will be observed that no reference is here made to the French coefficient of wear. Testing engineers are now practically unanimously in favor of abandoning this term. It really has no added significance, being merely the quotient obtained by dividing the constant 40 by the percentage of wear. It is rather difficult to discontinue the use of the term, however, because almost all highway engineers are accustomed to think only in terms of coefficients. With regard to tolerances which should be allowed when interpreting this test, it is probable that, in general, the test is not accurate to less than 0.5 per cent. for stone or 1 per cent. for slag or gravel, the difference being due to the fact that stone is usually more uniform than either of the other aggregates. Such a liberal tolerance is made necessary simply because the test can not be depended upon to give results with any greater degree of accuracy. Many attempts have been made to improve the method, but so far none of them has been adopted as standard.

Although stone may be tested for hardness, toughness, etc., in addition to the abrasion test, the writer believes that the latter is sufficient control when the material is to be used for concrete aggregate. In the case of stone to be used in the construction of bituminous macadam or bituminous concrete roads, however, the toughness test has been found to be of value. In the case of gravel, uniformity of quality is the most essential requirement. This means freedom from soft, disintegrated fragments and an impact test has been developed for determining the percentage of such fragments in a gravel sample. Sufficient data has not as yet been accumulated to permit setting any test limits. For slag, density is the chief requisite. To determine this, a test for weight per cubic foot of crushed slag is made. The usual requirements specify a weight of 75 lbs. per cubic foot for pavements. Many good slag concrete roads have been built, however, with slag running as low as 70 lbs. to the foot. It would seem, however, that this is about as low as one should go until further information regarding the use of light slag in pavements is available. The Bureau of Public Roads has constructed and is now testing an experimental concrete pavement in which a large number of samples of stone, gravel and slag of widely varying characteristics are used. The results of this test should throw considerable light on this important question.

Grading of Coarse Aggregate

The proper grading or size of coarse aggregate will depend on the type of construction. Practice as regards concrete pavements varies in different parts of the country, a maximum size of 2¾ in. being allowed in many of the eastern states. The chances are that the maximum size is not an extremely important factor provided the aggregate is well graded from coarse to fine. A sample showing anywhere from 50 to 75 per cent. retained on a screen intermediate in size between the largest and the smallest may be said to be satisfactorily graded. The maximum size of 2 in., which is allowed in Pennsylvania, New Jersey, etc., is largely due to the added cost of further crushing the very hard and tough trap rock quarried in this section. Experience so far seems to indicate that the large stone is satisfactory.

In applying tolerances in connection with results of grading tests, it has been the custom in the past to allow a variation not to exceed 5 per cent. larger than the minimum size, which is usually ¼ in. This is all right in theory but does not work out very well in practice because, as is well known, stone, in general, retained on a ¼-in. revolving plant screen will often contain as much as 1 5 per cent. passing a laboratory screen of same size. Likewise, the efficient working of some gravel pits require that the coarse aggregate carry considerable "tolerance" material. Purdue University recently conducted a series of tests to determine to what extent the so-called "tolerance" material was harmful, resulting in the conclusion that as high as 15 per cent. might be allowed without seriously affecting the strength of the concrete. The principal consideration affecting control tests for grading of aggregates is that the material run fairly uniform day to day. This is usually determined by testing with a set of field screens right on the job or at the producing plant. One additional point in connection with screen analyses of aggregates should be mentioned. Some specifications call for the material to be the product of the crusher passing a revolving screen with openings of a certain size, say, 3 in., and to be retained on a revolving screen with openings of a certain size, say, 1 in. Everyone who has had experience with crushing plant practice will realize how uncertain such a specification is. There are so many factors which influence the size of a stone product, such as the speed and angle of the screen, amount of moisture on the stone, etc., that the only safe plan is to specify that samples of the products be of definite size as determined by laboratory screens. Knowing these requirements, the quarry man can adjust his equipment so that they can be complied with. It will be found that this is a much safer plan than to be compelled to accept aggregates simply because they were produced in a plant having screens of certain specified size.

Stone for Macadam

Turning now to stone to be used in macadam construction, we find not only the abrasion test but the toughness test and sometimes the hardness test used in examining the material. In a macadam road, the stone being held in place by a more or less nonrigid binder is not supported on all sides to the same extent as the coarse aggregate in concrete. For this reason there is more chance for the individual fragments to wear in the macadam type and consequent a greater necessity for a tough, durable stone, especially under heavy traffic. The engineer is justified, therefore, in taking only the best available stone and the laboratory may often be of considerable assistance to him in making his selection. Good practice does not in general command the use of stone for bituminous macadam where the per cent. of wear is more than 5.5. The toughness likewise should be at least 6.0. For mixed bituminous concrete, a per cent. of wear of not more than 5.0 and a toughness of at least 8 is usually required. The type of stone should also be taken into consideration. Many engineers specify a lower percentage of wear for trap or granite than for limestone for a given construction. This is done because the trap and granite are naturally much harder than the limestone, so that a trap showing a percentage of wear greater than normal is likely to be disintegrated or otherwise to be of inferior quality to the limestone even though the actual wear as shown by the test is the same. Type is also an important consideration if water-bound or plain macadam construction is used. It is well known that certain types, such as the quartzite, gneiss, schists, etc., will not bond on the road and for this reason they should be used in the wearing course. Simple determination of type of road is all that is necessary in this case, which is partly the reason why the so-called "cementation test" for rock is not now used to any great extent.

Gravel for Surfacing

The testing of gravels for road surfacing is confined largely to a washing test to determine the percentage of clay present and a mechanical analysis to determine the grading of the sand and gravel from the maximum size down to dust, with the gravel fraction weighing about two-thirds of the total. Just enough clay should be present to act as a binder. The amount of clay to be allowed will depend on the character of the gravel, ranging from as little as possible in some limestone gravels to as high as 10 to 15 per cent. by weight in pure quartz gravels. The maximum size will vary with condition, but as a rule should not be placed at more than two-thirds the depth of the course when the gravel is to be used as a base and not more than 1½ in. for topping. The tendency recently has been for smaller gravel in the top. In order to control the quality of gravel for wearing course, an abrasion course is sometimes specified. Although when two or more available deposits are under consideration it is certainly advisable to take the one in which the best grade of stone occurs, it is not usually economically justifiable to reject local in favor of imported material supply on the score of an abrasive test. For this reason the writer would be inclined to waive this requirement under ordinary conditions provided the material was otherwise satisfactory. Due to the wide range in grading of the average gravel pit, it is essential that rather liberal tolerances be allowed if the road is to be built. For instance it is hardly practical to reject pit run material which varies from 50 to 75 per cent. retained on the ¼-in. screen. It is simply impossible in the case of most pits to secure material which will run any more uniform than this. Again, if a specification calls for a 10 per cent. clay content, some tolerance, say 5 per cent., may be allowed. It is seldom wise to allow a clay content in any case in excess of 20 per cent.

Paving Brick

About the only test to which vitrified paving brick is now subjected is the standard rattler test. This test has been used a great many years and has given, in general, entire satisfaction, although the writer believes that it, in common with many other tests, can be improved. About the only point to which attention should be called here is the effect of size and type of brick on the rattler loss. It is known that re-pressed brick will lose slightly less than wire cut brick of equal quality due to rounded edges of the former. Likewise, 3-in. brick will show a somewhat greater percentage of wear than 4-in. brick of equal quality due to the greater number of linear inches of edges in proportion to weight which are exposed to wear. In the absence of specific data, one would probably be safe in allowing a 1-in. differential in favor of the wire cut type over the repressed and a 1 to 2 per cent. differential for a 3-in. over a 4-in. brick.

Stone Block

Considerable trouble has in the past been experienced in the testing of stone block chiefly because of the attempt to apply the macadam stone tests in this material. The writer has discussed this point a number of times and it will not be necessary to go into details in this paper. Suffice it to say that the Deval abrasion test is not accurate enough to differentiate between the variuos grades of granite block on the market except in a very rough way. In other words, in using this test, no attention should be paid to a few tenths of a per cent. variation. The test will indicate the presence of soft, inferior stone and this is about as far as it can be depended upon.

Conclusion

In a paper of this length, it is of course impossible to go very much into the details of this important subject. It is hoped, however, that enough has been covered to indicate the major points to be considered. The object of the paper is to show the necessity of taking certain things into consideration when interpreting test data and when setting specification limits for materials. The fact that these things are not always considered is, the writer believes, the principal reason for much impractical interpretation of laboratory results. It is largely a question of mutual understanding, and the writer sincerely hopes that this paper will contribute at least slightly towards clearing up some of the doubtful points.

Canada's Fuel Problem

(Continued from page 1205)

In New Brunswick, the Minto district shipped coal to New Brunswick and Quebec.

Ontario and Quebec, he said, import considerable from the United States at various points of the border.

In Saskatchewan, Mr. Mountain said, the districts of Estevan and Bienfait supplied coal to Saskatchewan and Manitoba.

In Alberta, the principle mining points were: territory around Lethbridge, Kipp, Taber and Grassy Lake; Drumheller district; Brazeau district; Edmonton district, including Cardiff, Clover Bar, Camrose. Dinant, Roundhill and Tofield; Mountain district, including Mountain Park, Lovett, Coalspur and Brule; the Canmore and Banghead districts. All these districts, he said, ship domestic and steam coal throughout the prairie provinces and also to points in British Columbia.

Other districts, such as the Crow's Nest group, were divided between Alberta and British Columbia. These were; Bellevue, Blairmore, Hillcrest, Coleman, Michel, Fernie, etc., from which points coal was shipped both westerly and easterly.

In British Columbia the Merritt district on the Kettle Valley Railway including such mines as Merritt, Nicola, Penticton and Coalmount shipped to the various interior as well as coastal points of British Columbia.

On the Pacific Coast, there were a number of mines in Vancouver Island which supplied the requirements of the island as well as up and down the coast.

Ventilation Principles and Practice

(Continued from page 1208)

sidered. Technicalities have purposely been avoided, as these properly belong to the technical man, and, moreover, justice could not be done to the theoretical or technical considerations of any one part of a ventilation, such, for instance, as fans or ducts, without occupying considerably more space than has been taken in these notes for a general resume of the subject.

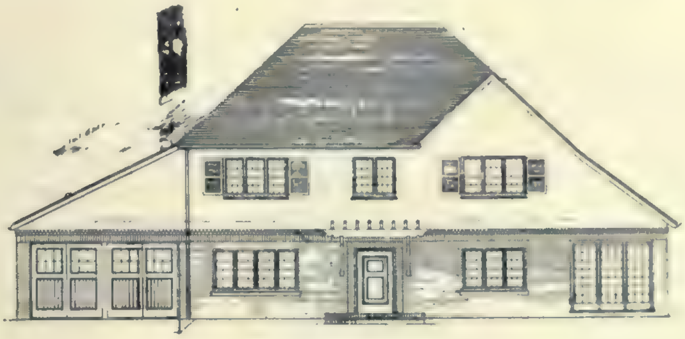
The Contract Record's

Weekly House Suggestion No. 49

Our house subject this week is an interesting study in the better-class type of residence. This house was completed recently on Edgar Ave., Toronto, for Mr. J. E. Davies and incorporates a number of excellent features readily apparent to the reader in the reproduced plans below.

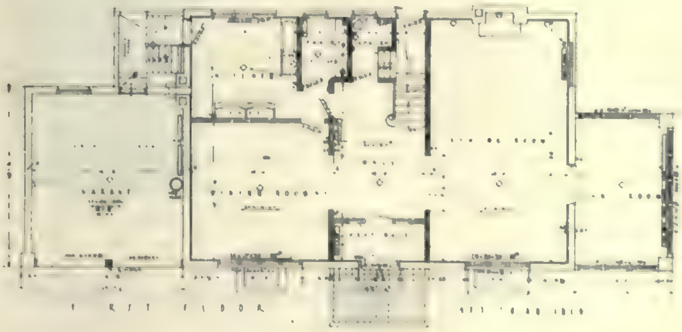
The exterior construction is rug brick on the first storey, with stucco on tile above. All windows are of the casement type, and the roofing is wooden shingles, stained a moss green. The main entrance is very simply treated and has a brick base. The large living room to the right is the feature of the ground floor layout. This room runs the full width of the house, 28 ft., and is equipped with a fireplace in the rear wall. The sun room, to the right of the living room, is enclosed entirely in glass, with full length French glass doors at the front. The reproduced plan immediately suggests to the reader the feature of convenience of layout incorporated by the designer and needs no further comment. The coat room at the rear of the main hall is equipped with a wash basin. The kitchen and pantry arrangement is ideal, being readily accessible to the dining room and well isolated from the living room. The large two-car garage at the left has a separate entrance at the rear on the rear porch, thus making it possible to gain access from the house without going outside. The flooring throughout this main floor is of red oak, with the exception of the kitchen and pantry, which are laid with pine. Trim is in oak.

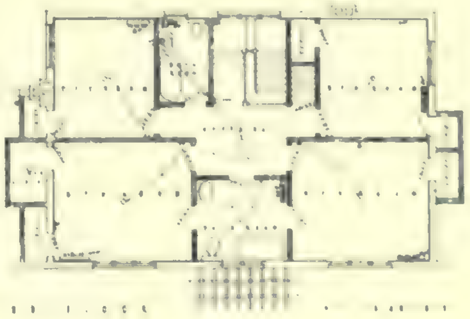
The upstairs layout requires little explanation. The rooms are all large and are all located immediately off the square hall. The two front bedrooms have private entrances on the main bathroom. Both bathrooms have tile walls and floors and the flooring throughout the balance of this storey is of red oak, as downstairs. The trim, however, is birch, stained mahogany.



The basement plan, not shown, incorporates a beautiful large billiard room finished in cypress and equipped with a large fireplace of brick construction. This room is immediately under the living room and is exactly the same size as the latter. There is a W. C. situated convenient to the billiard room. The balance of the basement is taken up with laundry, boiler room and coal bins. There is a separate entrance from the outside on the laundry.

Mr. J. W. Siddall, architect, Confederation Life Building, Toronto, was the designer of this home.





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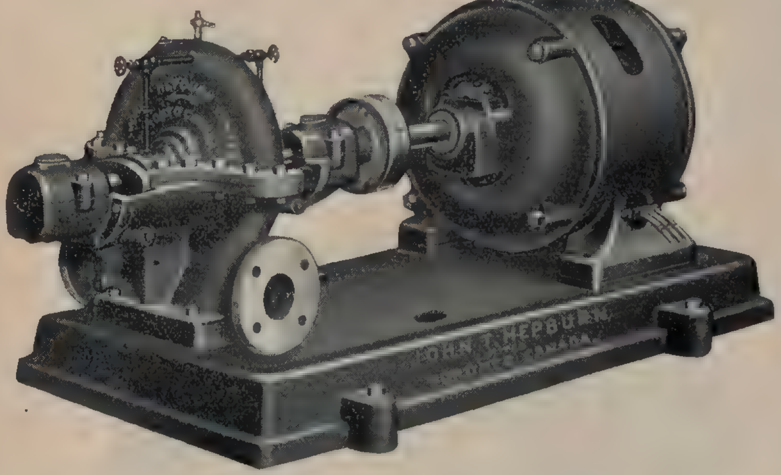

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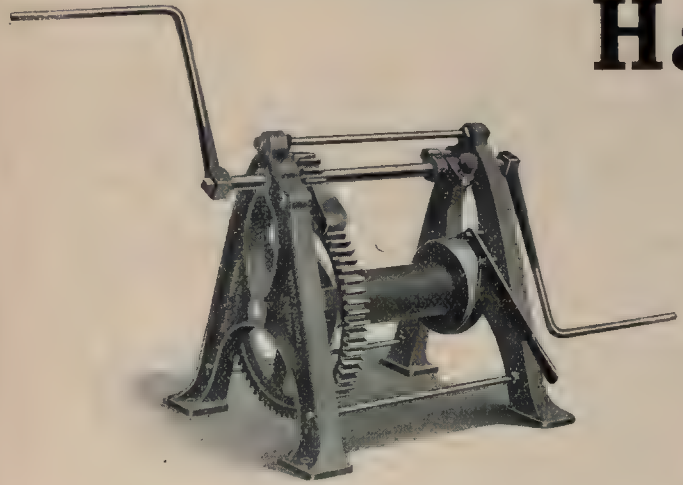

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Mussens Limited
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(Continued on page 8)

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Hamilton, Canada **LIMITED**

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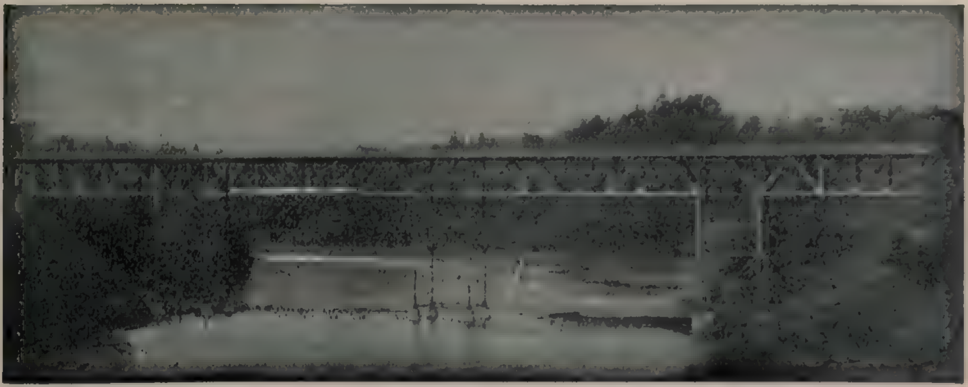
Engineers, Manufacturers and Contractors



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"Our accomplishments demonstrate our ability"

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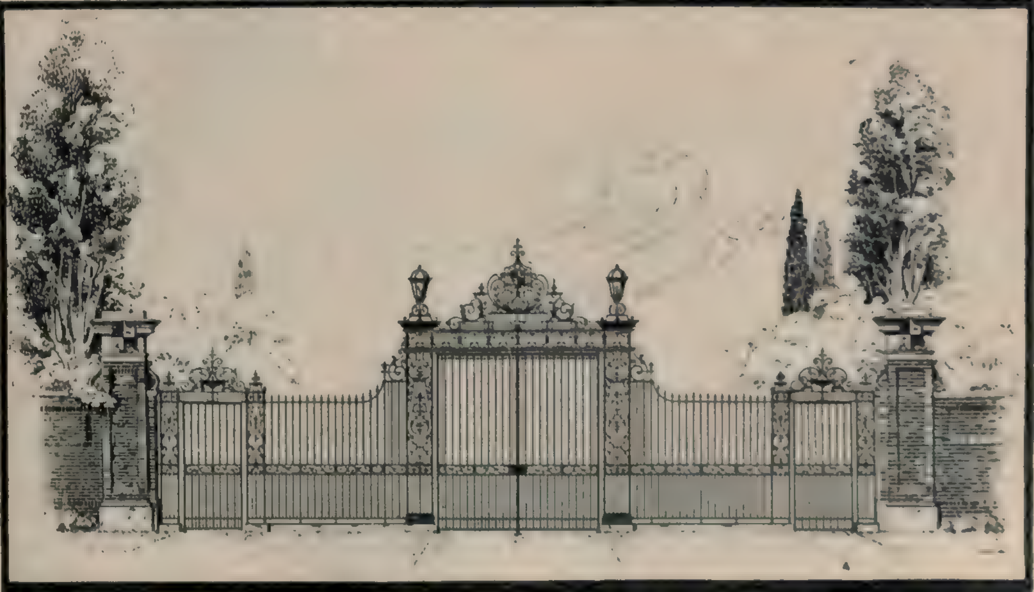

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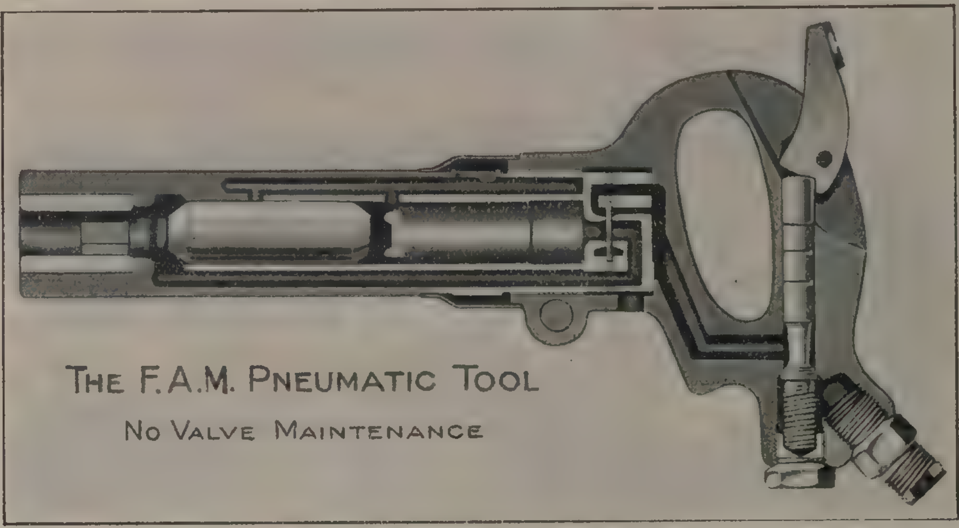
The SIMPLEST The most ECONOMICAL The most POWERFUL



The valve mechanism of this tool is not affected by dust or temperature, will not stick, and has no complicated parts. LESS air consumption than any other make of tool.

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A MILE OF RAWLPLUGS

in the

Mount Royal Hotel, Montreal

The RAWLPLUGS used in the construction of Canada's newest and largest Hotel if placed end to end would extend for one mile.

40,800 screws were fixed with RAWLPLUGS in this Hotel.

For fixing Bathroom, Toilet and Barber Shop fixtures RAWLPLUGS Nos. 12 x 2" and 8 x 1½" were used by the T. J. Dyer Co.

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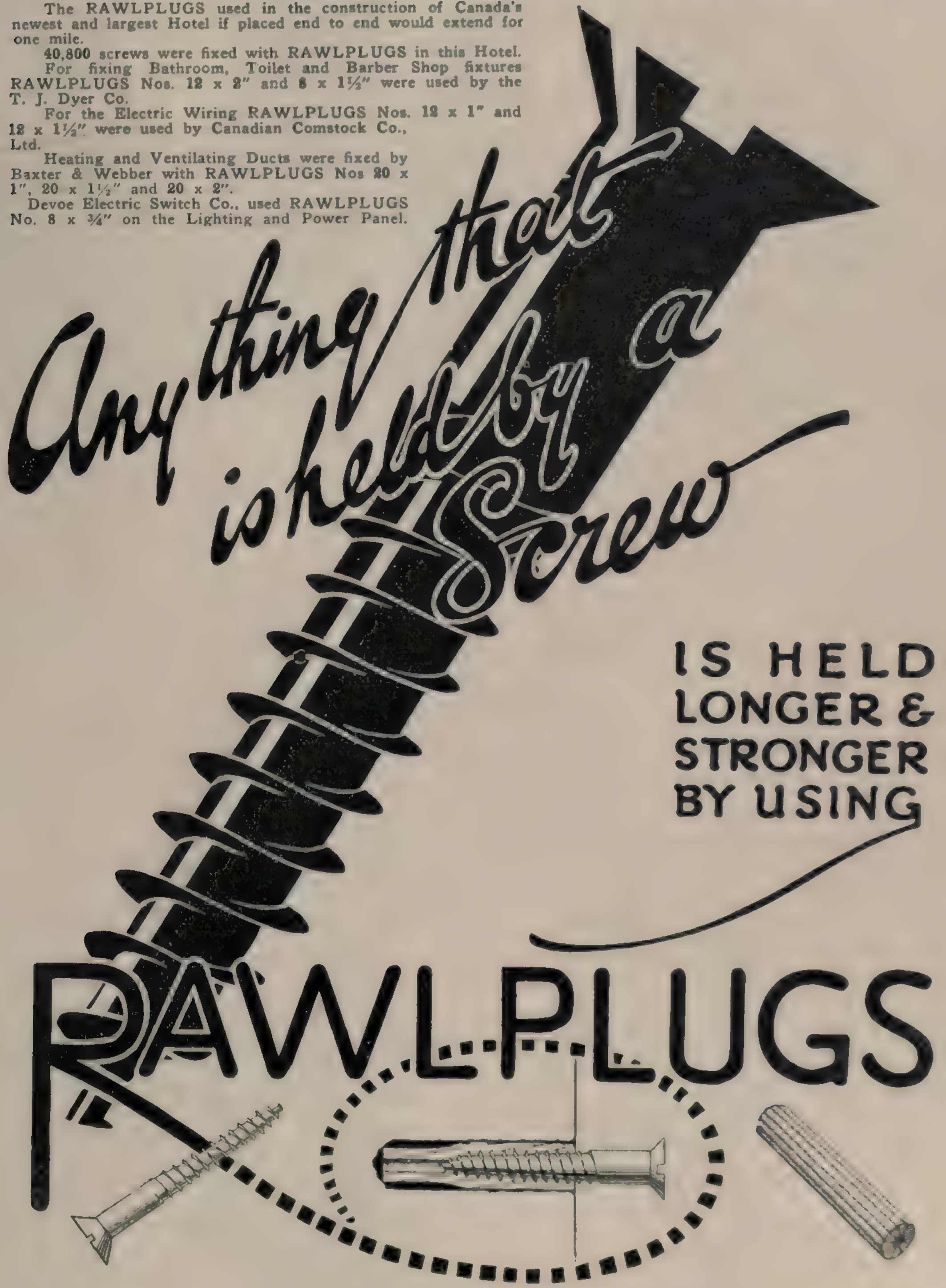
Anything that is held by a Screw
IS HELD LONGER & STRONGER BY USING
RAWLPLUGS

FIX IT WITH RAWLPLUGS

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  - Dom. Tar & Chemical Co Ltd.
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  - Mussens Limited
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One of the Season's Big Jobs - built with Don Valley Brick

THE Muskoka Hospital for Consumptives at Gravenhurst, Ontario, was built entirely by public subscription. The money, therefore, had to be spent to the greatest advantage and those in charge realized their great responsibility.

Before choosing the brick and terra cotta, exhaustive investigations were made into the merits of the market's various offerings. To say that "Don Valley" was the final choice, therefore, is saying a great deal for this well-known brick which undoubtedly was chosen because of its exceptional beauty, texture and wearing qualities.

300,000 exterior face brick.
20,000 interior face brick.
1,000,000 common and stock brick.
20,000 enamelled brick.
Fireproof Terra Cotta Roofing for the entire building, supplied by Don Valley Brick Works.

Get full particulars

Any information you desire concerning our various grades of brick and their prices will be gladly forwarded upon request.

DON VALLEY BRICK WORKS
Head Office: Dominion Bank Bldg., Toronto
BRICK YARDS: DON VALLEY, TORONTO

What Does a Review of the Past Season's Building Activities Show?

A review of the past season's building activities show unmistakably that Gypsum products are growing in favor. The plain fact is—builders, contractors and owners are realizing that Gypsum offers so many advantages over every other type of building materials that it cannot be ignored.

Take Gypsum Board for instance. Here is a material practically indispensable in the modern home. It provides a fireproof wall of great rigidity; permanent and economical. It prevents plaster cracks, lath stains and all the disagreeable features of the old fashioned lath and plaster wall. It is an effective insulator. It avoids plaster waste. It unites with Gypsum Plaster in a wall as solid as a rock, making a perfect foundation for wall decoration. In short, it is the ideal, logical material for wall construction. And this fact is fast becoming recognized in the building world.

A FIRE CHIEF'S TESTIMONIAL

R. Pritchard, Fire Chief of Chatham, Ontario, in a letter to us expressing his opinion of Gypsum products—following the demonstration of August 30th at the Fire Chief's Convention—says, "I am of the opinion that Gypsum Board, Gypsum Block and Gypsum Plasters are fire retardent materials of an exceptional character and do not hesitate suggesting and commending their use in all kinds of building work."

Gypsum Products

If you have not complete data describing Gypsum Board, Gypsum Block and Gypsum Plaster, on file, drop us a card and they will be forwarded immediately.

Why Build to Burn?

The Ontario Gypsum Company, Ltd.

HEAD OFFICE: Paris, Ont.

Toronto Offices: 106 Don Esplanade Montreal: 374 Beaver Hall Square

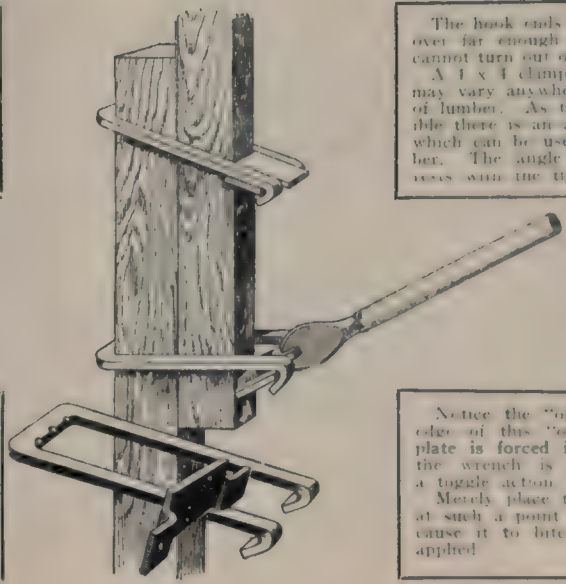
Factories: Caledonia, Ont., Lythmore, Ont.

ANNOUNCEMENT

The straight arms of the clamp give maximum strength and eliminate the possibility of distortion from stresses caused by the application of the clamp to over-sized lumber or to extreme loads.

The hook ends of the clamp are bent over far enough so that the lockplate cannot turn out of its intended position.

A 4 x 4 clamp fits two 4 x 4s that may vary anywhere from 6½" to 8½" of lumber. As the lockplate is reversible there is an additional ½" take up which can be used on very small lumber. The angle at which the clamp rests with the timbers is unimportant.



When the clamps are applied it is not necessary to have a load on the timber in order to keep the clamps in place—they can be handled as though being one piece.

The lockplate goes on the piece that supports the weight from above.

Notice the "off set" lockplate. The edge of this "off set" portion of the **plate is forced into the lumber when** the wrench is pulled down causing a toggle action.

Merely place the edge of the plate at such a point on the timber as will cause it to bite when the wrench is applied.

ROGERS TIMBER CLAMPS

(U.S. Patent No. 1437019)
Foreign Patents Applied for

Shoring and Scaffolding

Pay for themselves on first job.

DRUMMOND & REEVES LIMITED

43 Jarvis Street, Toronto, Canada   **Phone Main 331**

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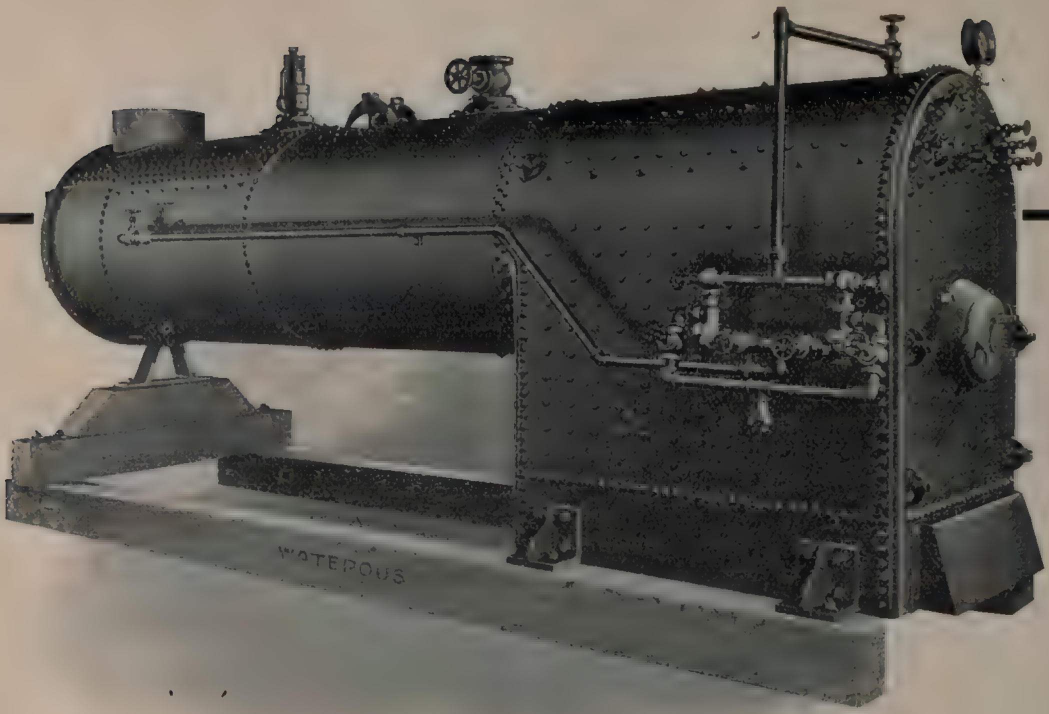

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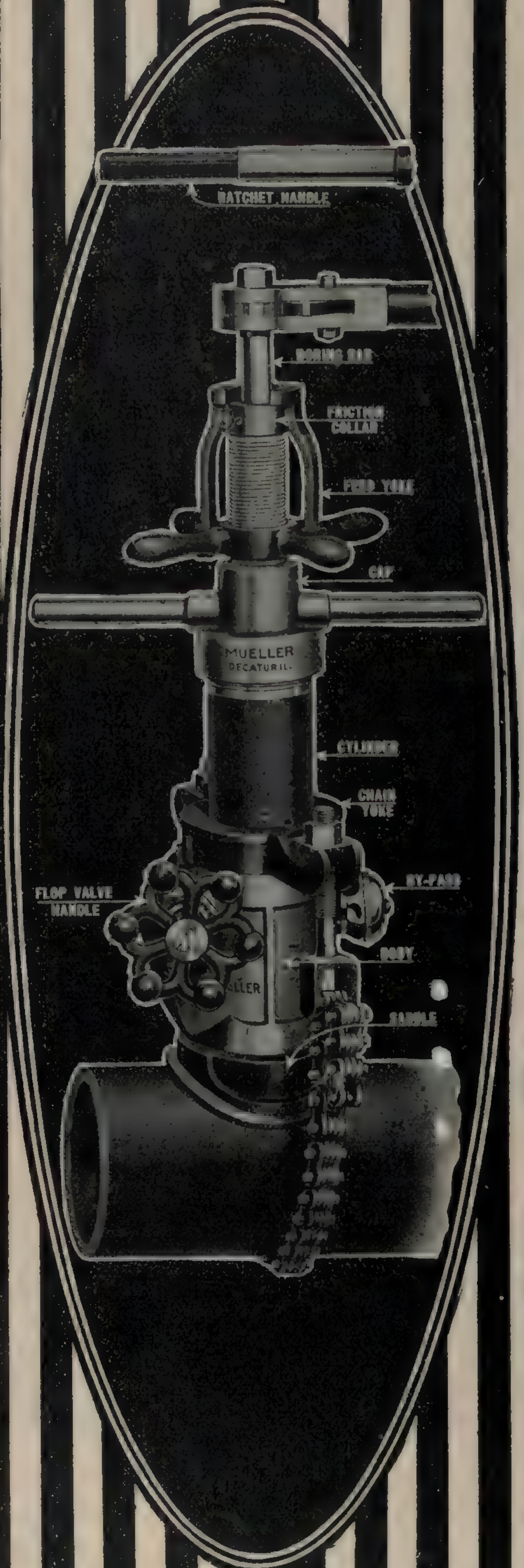

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General view of plant at Cheltenham.

Interior of Down draft Kiln.

Car of finished brick coming from Tunnel Kiln.

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Exterior of Down draft Kiln.

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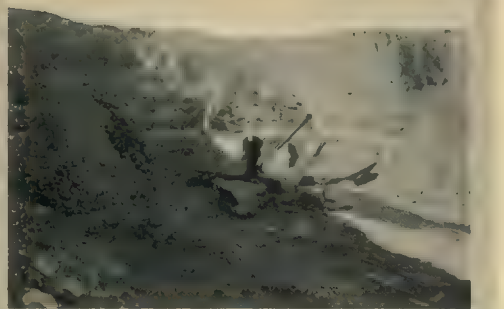
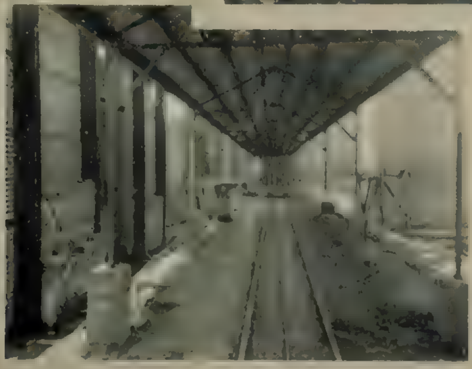
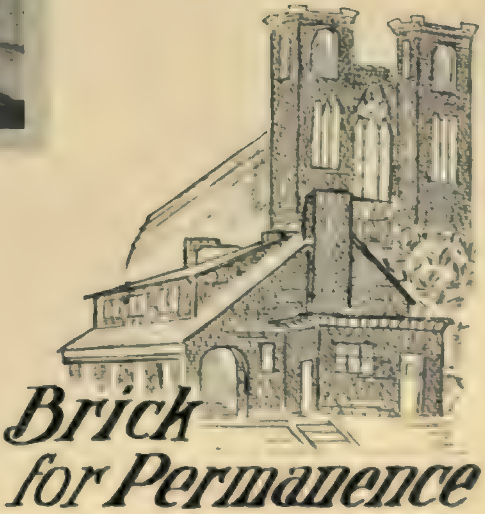


Shale pit at Cheltenham.



Car of unburned brick going to Tunnel Kiln.



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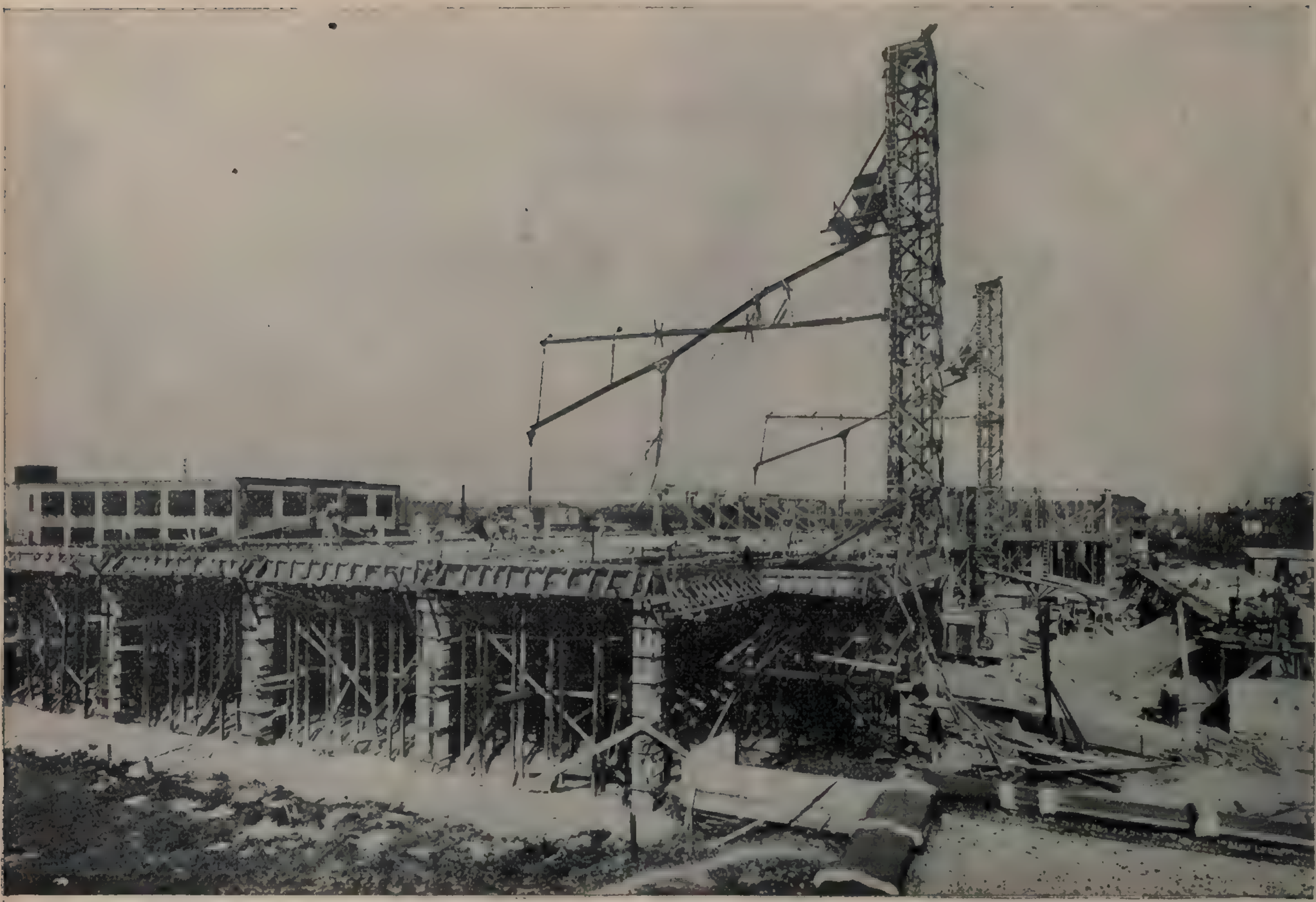

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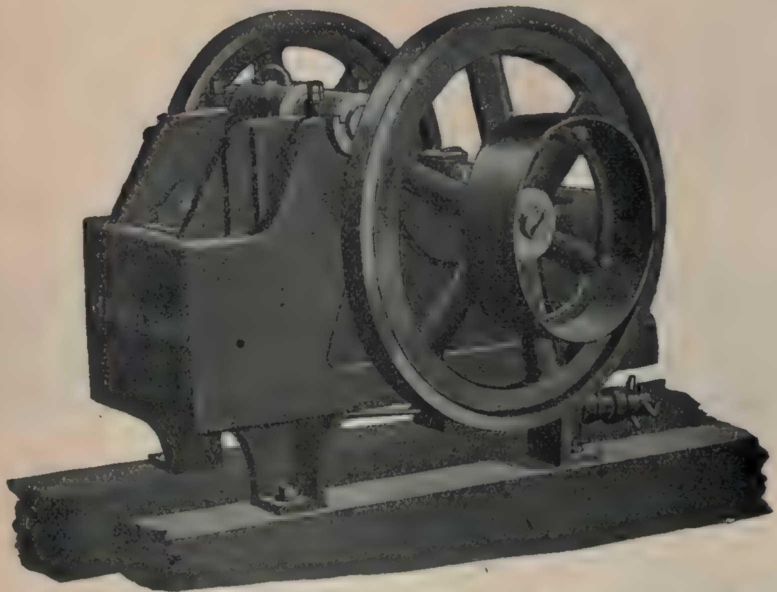

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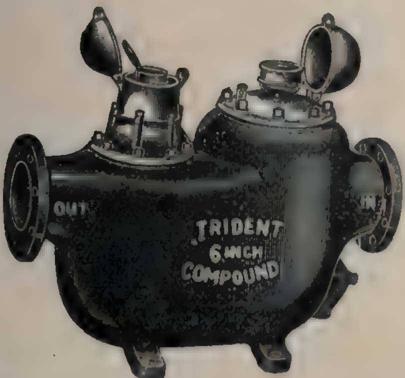

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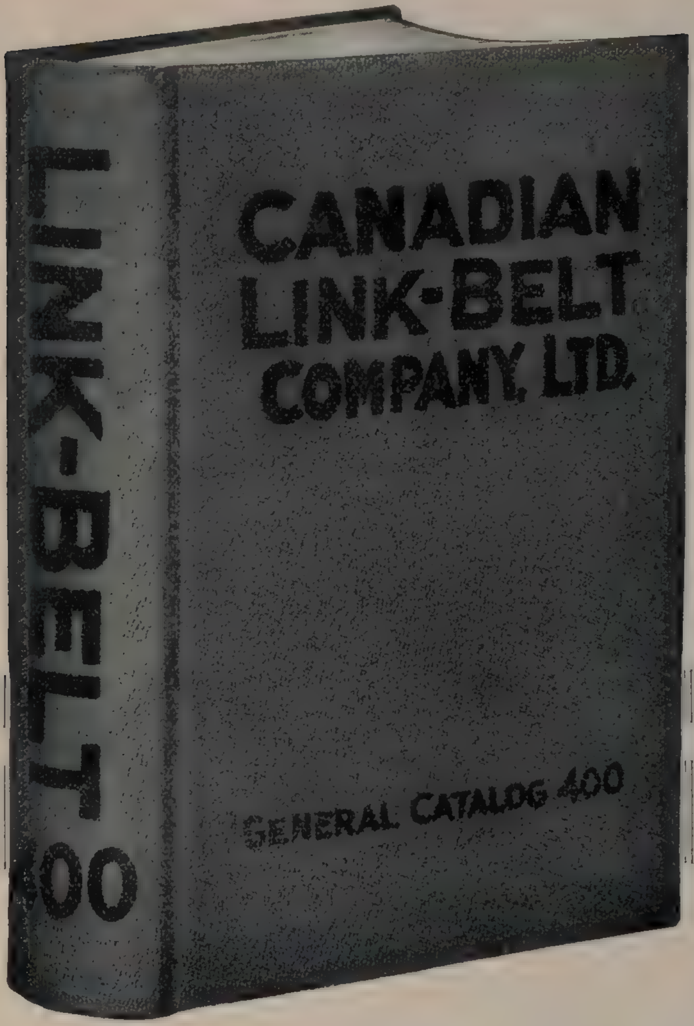

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Harbour Head Walls under construction showing pre-moulded blocks in place

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For the Harbour Head Walls, from Bathurst Street to Yonge Street, the structure consists of rock-filled crib work.

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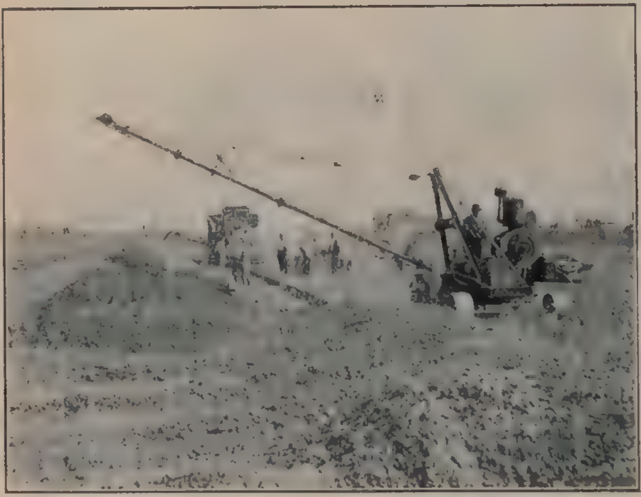

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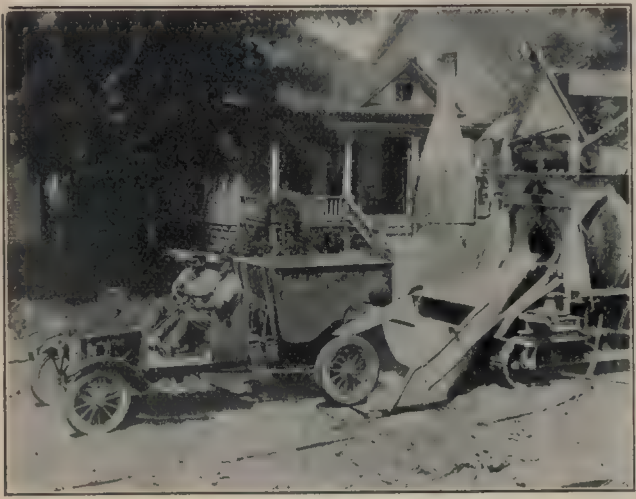
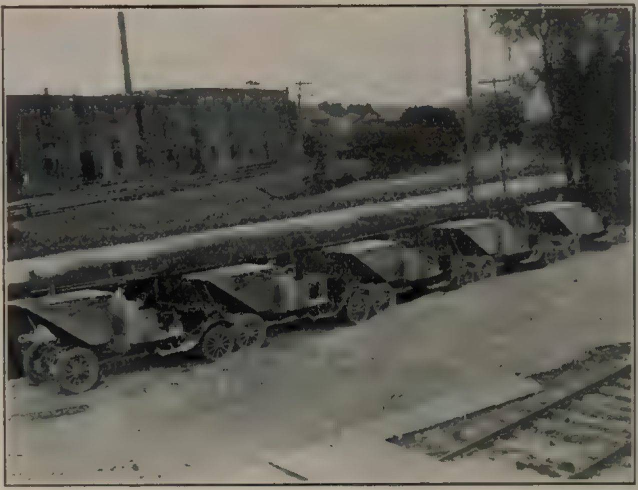


Paving in Leamington, Ont., 1922



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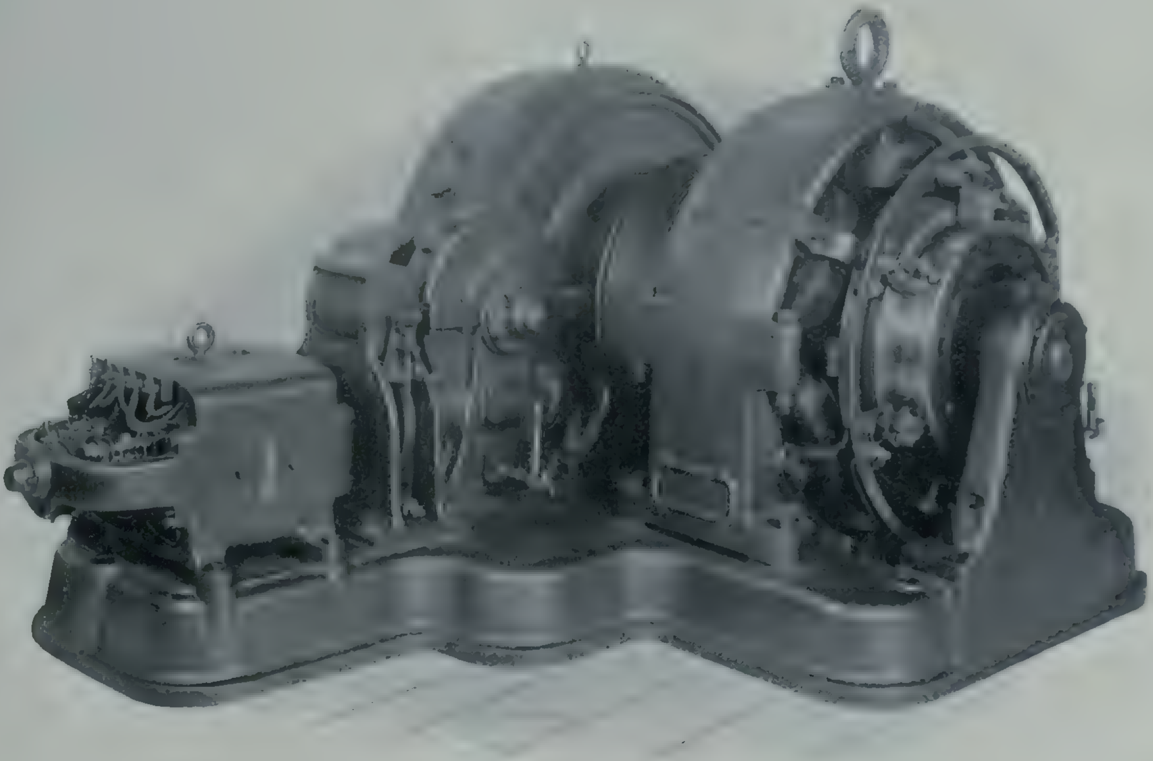

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4	405 H.P.	200 lbs.	1917
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2	405 H.P.	200 lbs.	1921
	fitted with built in Steam Superheaters.		

Refinery at Sarnia, Ontario:

No.	Rated Capacity	Working Pressure	Year Installed
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Refinery at Regina, Saskatchewan:

No.	Rated Capacity	Working Pressure	Year Installed
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Yours very truly,
T. MONTGOMERY, Chief Engineer.

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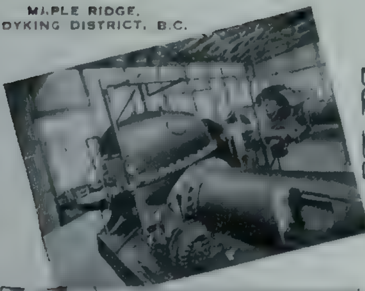

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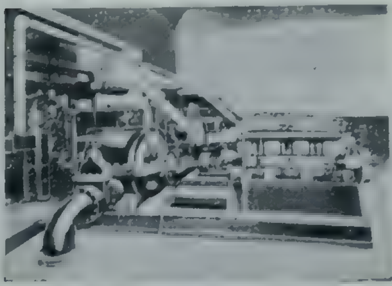

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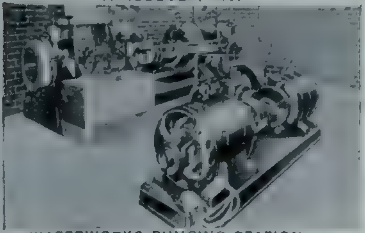

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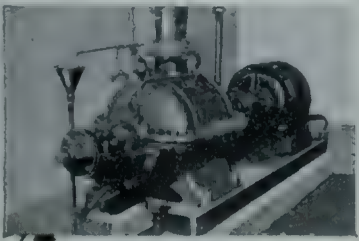

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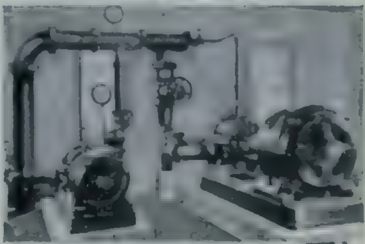

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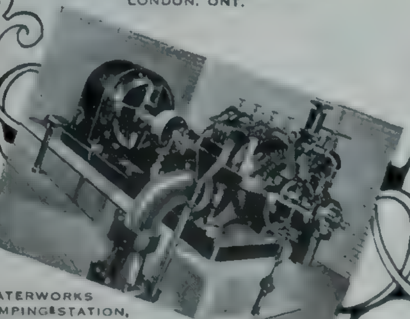

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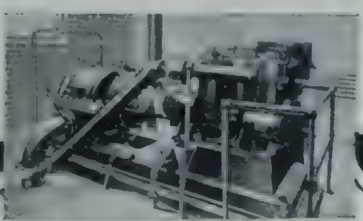

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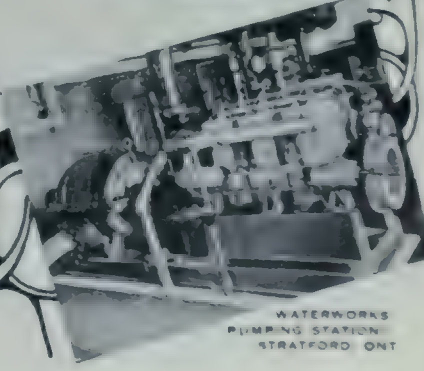

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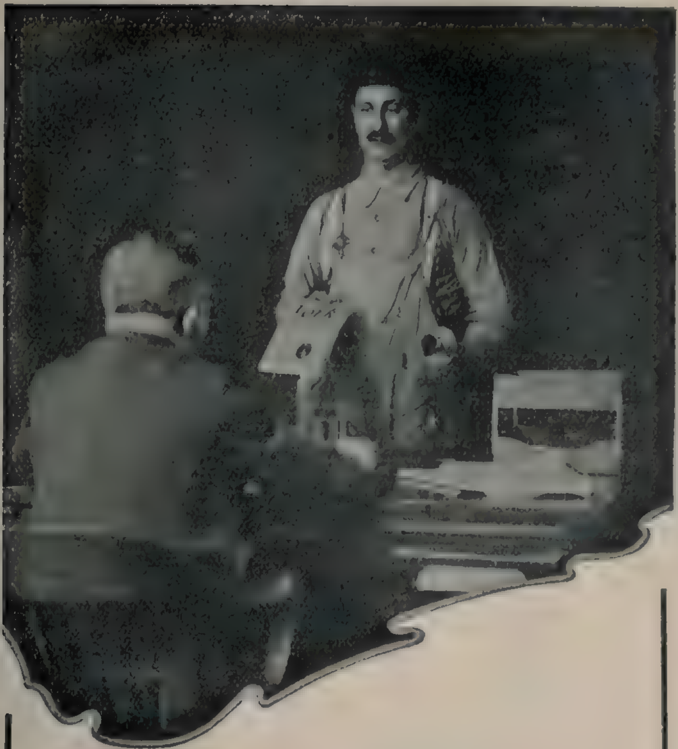

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Ice Making and Refrigerating Machinery Exclusively
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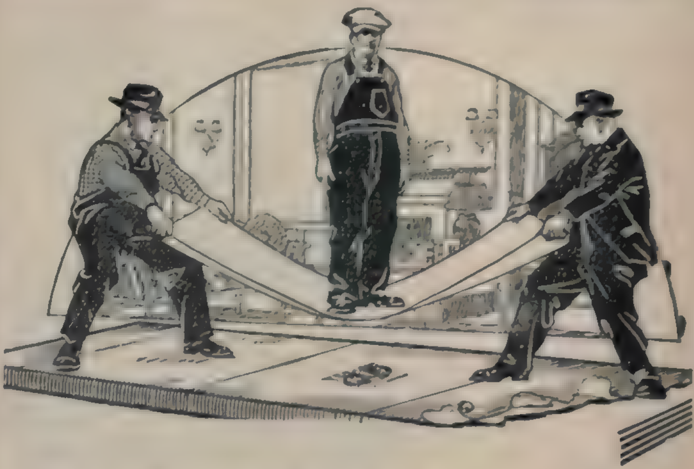

You Know In Advance How This Board Will Stand up—The Tests Are Its Guarantee

What a big advantage it is to be absolutely sure that your walls and ceilings will not crack, crumble, shrink or sag—that they will keep out dampness, heat and cold if built with

TEN TEST TRADE MARK THE BOARD WITH THE 10 TESTED FEATURES SOLID FIBRE BOARD

You have that assurance because ten of the severest tests a prominent consulting engineer could devise, were made with Ten Test Solid Fibre Board, to prove that it is ideal for exterior or interior walls and ceilings—is weather-proof, cold proof, heat proof, sound proof, fire and moisture resistive can be papered, painted or kalsomined—that it holds stucco to its surface with an everlasting grip—and finally that it is permanent and the most economical building material you can use.

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That explains the ten tests in detail; and illustrates beautiful homes built with this superior building board. Address your nearest representative or

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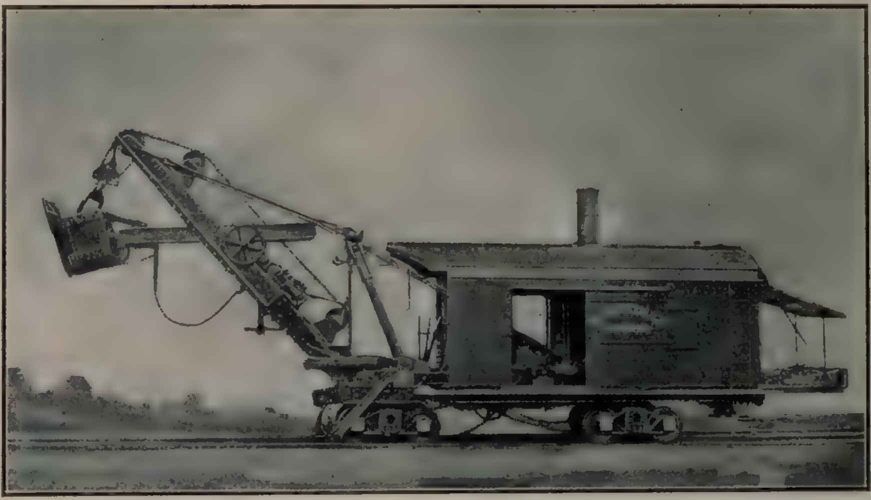
What Why and How to Build with
TEN TEST
SOLID FIBRE BOARD



Special Offering

Model No. 41 Marion Steam Shovel

Shop No. 2832

SPECIFICATIONS

Weight lbs.	In working condition	95,000
	In shipping condition	81,000
Size of dipper, cubic yards		1½
Capacity per hour (cubic yards)		60 to 180
Boom	Combination type, length	20' 0"
	Swings back of right angle	40°
Length of dipper handle		12' 6"
Car body	Width	7' 0"
	Length (overall	29' 10"
Boiler	Locomotive type, size	50" x 10' 0'
	Maximum press, designed for	150
	Working pressure	125

Size of engines	Hoisting	8" x 8"
	Swinging	5½" x 6"
	Crowding	5½" x 6"
Capacity of water tanks, gallons		770
Height of A-frame lowered for shipment		
Size of hoisting chain		1"
Size of swinging	Chain	
	Cable, double	1"
Size of propelling chain		1"

A. A. SCULLY, LIMITED

123 BAY STREET
TORONTO
Phone Main 2800

Build a Road That Resists Bombardment

When the mighty guns on the Western Front hurled broadsides of ponderous steel projectiles, the turrets and forts, regarded as impregnable, crumpled like cardboard. The result was a resort to earth trenches and embankments. Why? Because the only resistance possible was that of absorbing the shock instead of defying it. The same principle dictates shock absorbers and pneumatic tires for automobiles and trucks to protect the vehicle and its load. Our streets and roads must withstand the bombardment of more than four million truck wheels. The shock absorber in this case is the asphalt wearing course whatever the base. Asphalt—resilient, dustless, noiseless, waterproof, wearproof—the pavement of Broadway, Fifth Avenue, Michigan Boulevard, Broad Street and Pennsylvania Avenue, is the last word in modern pavement design and is no more costly than a rigid unprotected pavement.

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HOISTING ENGINES

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LIMITED
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MONTREAL
WORKS: WELLAND ONT.

"MEAD-MORRISON"

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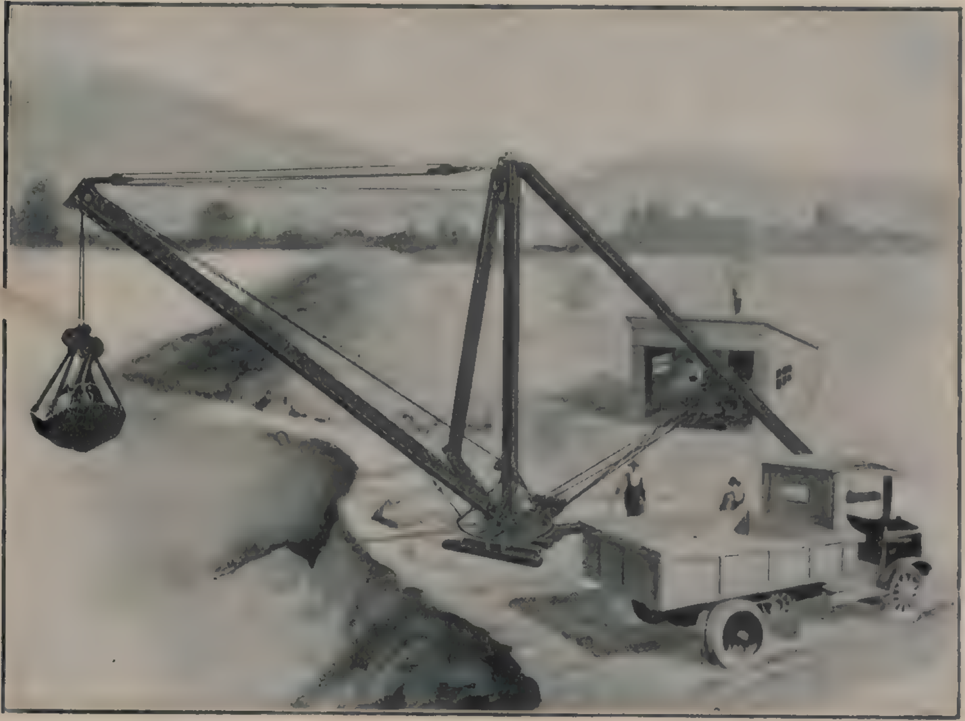
FOR STIFF LEG AND GUY DERRICKS



Mead-Morrison Derrick Fittings are of the latest, most approved type, developed by engineering ability of the highest class after many years' experience in design, manufacture and use of Contractors' Equipment.

All details of construction have received most careful attention, thus insuring dependability under the severest service.

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"Red Rustic", "Red Vertical",
"Red Pressed", "Buff Rustic",
"Buff Vertical", "Buff Pressed",
"Manganese Rustic", "Manganese Vertical"

Also "Delco" Hollow Tile.
Reg'd.

They will stand the test

Manufactured by

National Brick Company of LaPrairie
Limited
Montreal

When Specifying——

We are deeply indebted to Mr. Jas. Govan, M.R.A.I.C., Architect for Department of Provincial Secretary; Professor L. M. Arkley, M. Sc., M.E.I.C., Queen's University, and Professor Robert W. Angus, B.A. Sc., M.A.S.M.E., M.A.W.W.A., Toronto University, for the following compilation of data resulting from extensive tests made to determine the loss of heat through masonry walls.

Type of Wall	B.T.U's Transferred per 1 degree difference of temperature per hour per square foot.
9" Brick wall	.392
8" Tile wall—cells vertical	.416
8" Interlocking Tile wall	.313
12" Tile Wall—cells vertical	.322

Findings

(1) Hollow Tiles whose air cells lie **horizontally** when laid in the wall have a **lower** heat loss per square foot than solid brick walls.

(2) Hollow Tiles whose cells stand **vertically** when laid in the walls have a **greater** heat loss than solid brick walls.

(3) Interlocking Tile walls have a 21% **lower** heat loss than solid brick walls and 25% **lower** than vertical cell tiles.

(4) **An eight inch wall** of Interlocking Tile has a lower heat loss per square foot than an equivalent area of **twelve inch wall** built of tiles whose cells stand vertically in the walls.

The table above shows the results of the tests, supporting the deductions stated, the unit of heat measurement being the British Thermal Unit (B.T.U.)

All walls tested without plaster.

From a standpoint of insulation and fuel saving the above data constitutes a most important contribution.

The Interlocking Tile Company Limited

32 Toronto Street

Toronto - - Ontario

BERG DRY and WET PANS
For
QUALITY ECONOMY SERVICE

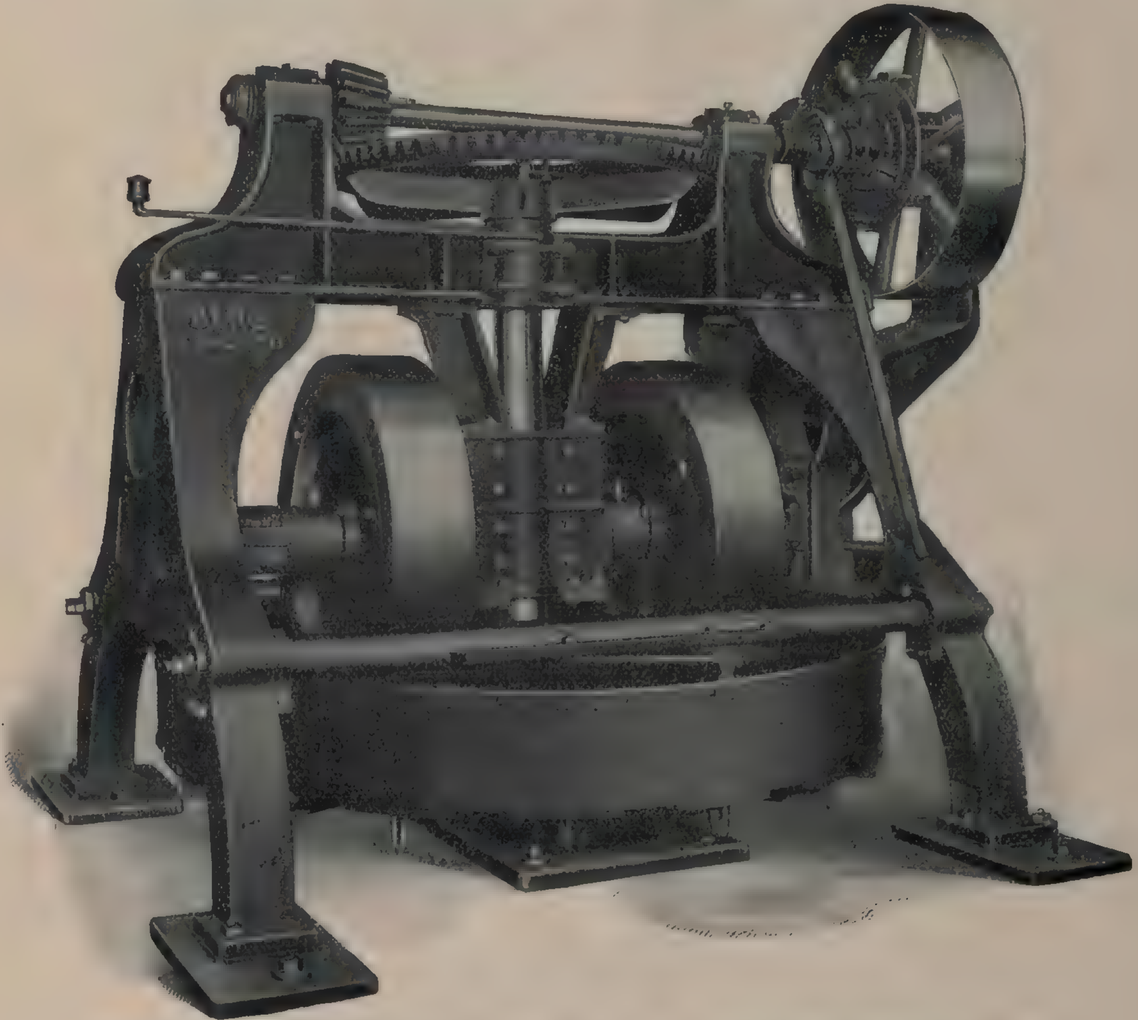

FIG. 314 HEAVY DUTY NINE FOOT DRY PAN—INDEPENDENT MULLERS

MALLEABLE IRON SCREEN PLATES

Eliminate Breakage
Give Greater Grinding Capacity, and
50% Greater Screening Capacity than Cast Iron Screens.

BERG SELF-ALIGNING BALL-BEARING PAN STEP

SAVES 50% OF POWER
SMALL OIL CONSUMPTION
ELIMINATES STOPPAGES
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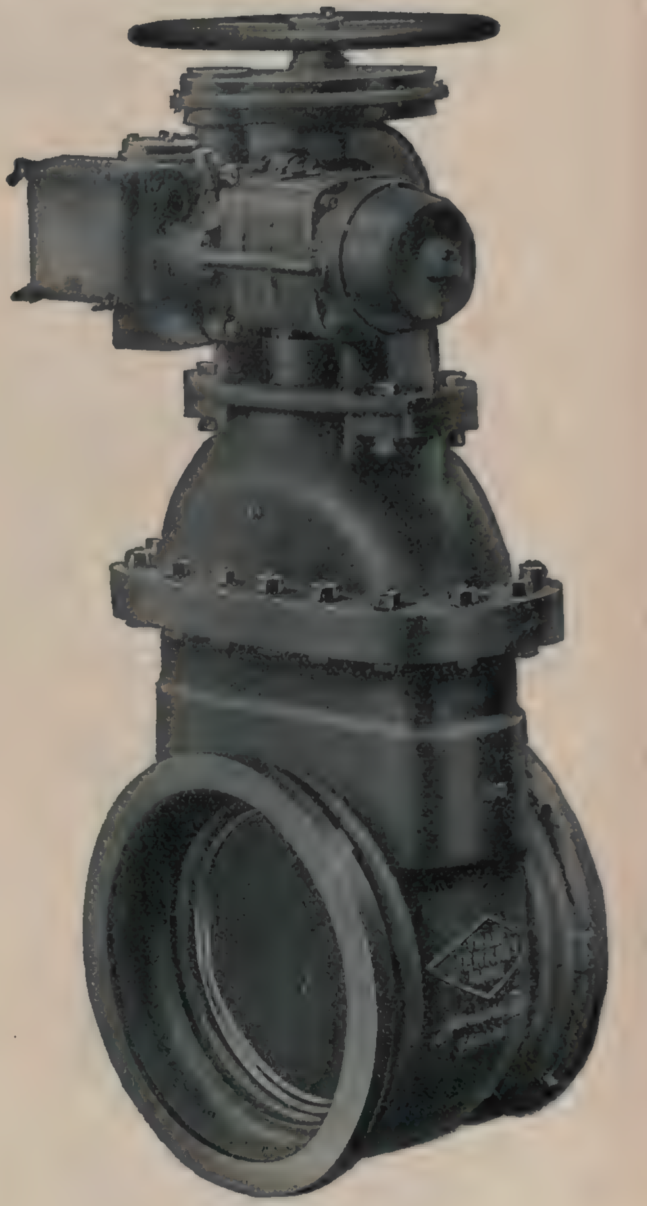

Note the outstanding features of this Jenkins Model—

Adaptable to inside Screw and Rising Steam Valves.

Positive in operation. Standardized equipment with Valve Manufacturers.

Operation from any electric circuit.

Short or Long Distance Control.

No overtravel of Gate. Heavy unseating blow.

Designed for any pressure, size or location.

Equipped with hand wheel for emergency operation, enclosed driving gears, waterproof limit mechanism and waterproof motor.

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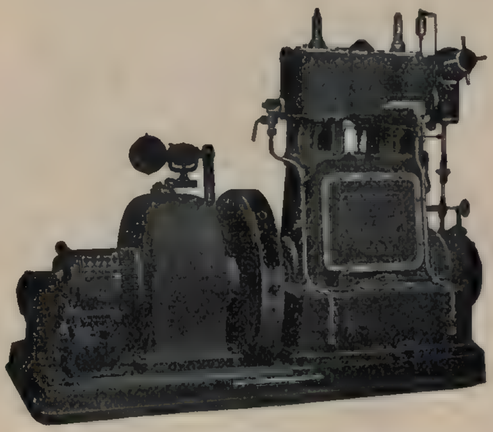
Our plasters have stood the test of time for over fifty years



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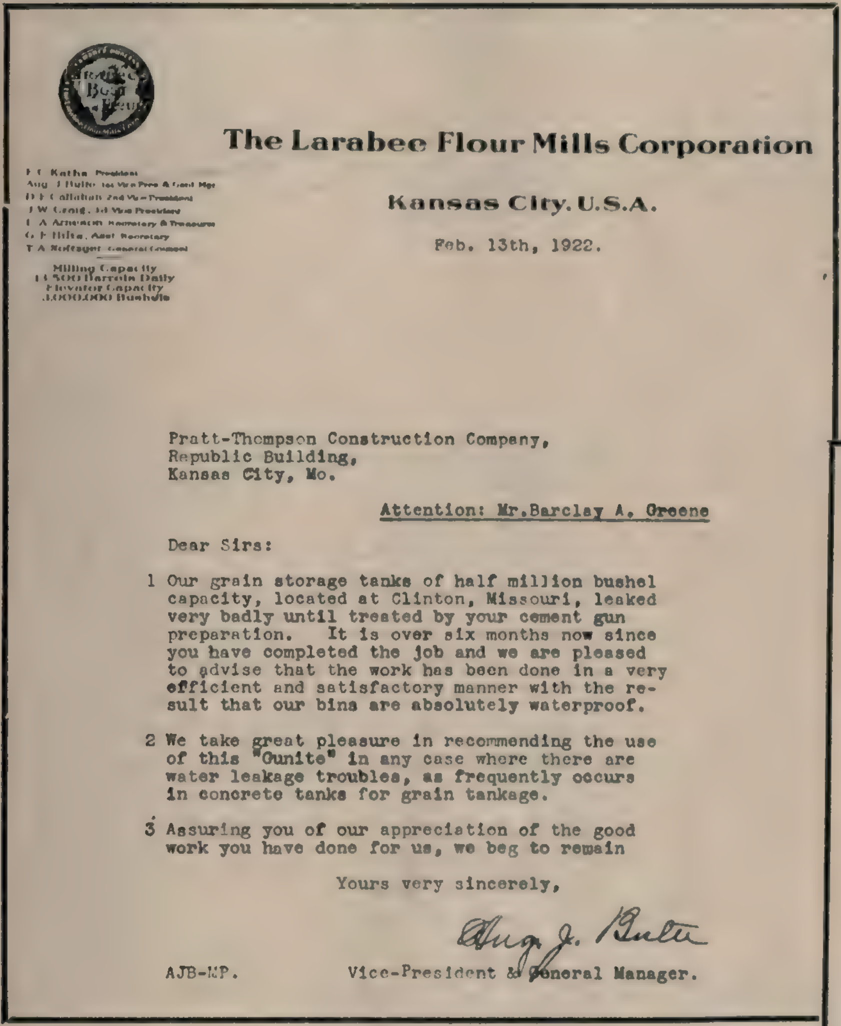

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11,500 Barrels Daily
Elevator Capacity
3,000,000 Bushels

Kansas City, U.S.A.

Feb. 13th, 1922.

Pratt-Thompson Construction Company,
Republic Building,
Kansas City, Mo.

Attention: Mr. Barclay A. Greene

Dear Sirs:

1 Our grain storage tanks of half million bushel capacity, located at Clinton, Missouri, leaked very badly until treated by your cement gun preparation. It is over six months now since you have completed the job and we are pleased to advise that the work has been done in a very efficient and satisfactory manner with the result that our bins are absolutely waterproof.

2 We take great pleasure in recommending the use of this "Gunite" in any case where there are water leakage troubles, as frequently occurs in concrete tanks for grain tankage.

3 Assuring you of our appreciation of the good work you have done for us, we beg to remain

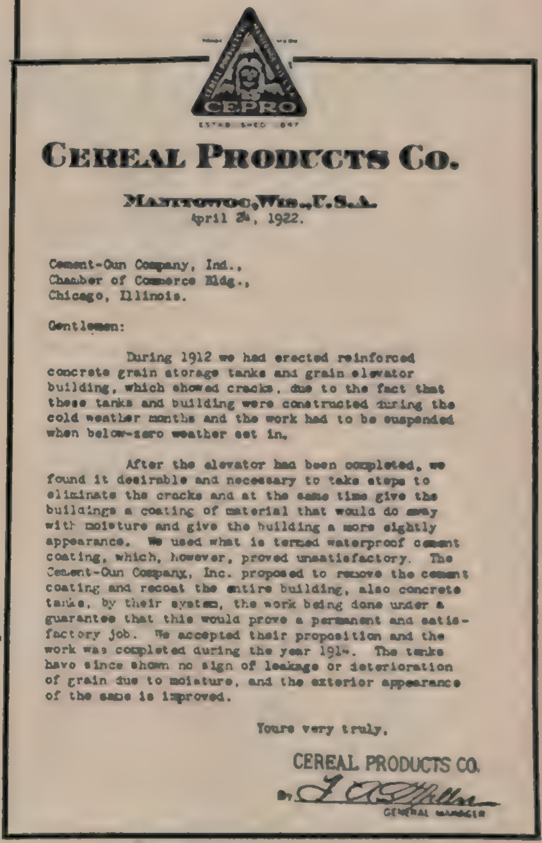
Yours very sincerely,

Aug. J. Bulte

AJB-MP. Vice-President & General Manager.

CEMENT-GUN
TRADE MARK

Making
Grain Elevators
Leak-proof and
Moisture-proof



CEPRO

CEREAL PRODUCTS CO.

MANITOWOC, WIS., U.S.A.
April 2d, 1922.

Cement-Gun Company, Inc.,
Chamber of Commerce Bldg.,
Chicago, Illinois.

Gentlemen:

During 1912 we had erected reinforced concrete grain storage tanks and grain elevator building, which showed cracks, due to the fact that these tanks and building were constructed during the cold weather months and the work had to be suspended when below-zero weather set in.

After the elevator had been completed, we found it desirable and necessary to take steps to eliminate the cracks and at the same time give the buildings a coating of material that would do away with moisture and give the building a more sightly appearance. We used what is termed waterproof cement coating, which, however, proved unsatisfactory. The Cement-Gun Company, Inc. proposed to remove the cement coating and recoat the entire building, also concrete tanks, by their system, the work being done under a guarantee that this would prove a permanent and satisfactory job. We accepted their proposition and the work was completed during the year 1914. The tanks have since shown no sign of leakage or deterioration of grain due to moisture, and the exterior appearance of the same is improved.

Yours very truly.

CEREAL PRODUCTS CO.
By
General Manager

Read these two letters telling how two grain elevators, treated with GUNITE, have been permanently insured against dampness and deterioration of Grain. And now read this lesson into *your* problems ! !

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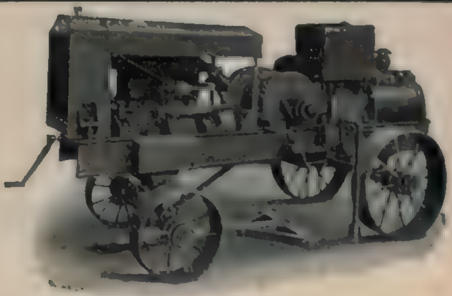
Foreign Agency: International Cement-Gun Company,
50 Maria Plaats, Utrecht, Holland



The Traylor Portable Compressor is built for GUNITE work, driving jack-hammer drills and all pneumatic tool work. Built in two sizes and driven by either electricity or gasoline through worm gearing.

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When the mighty guns on the Western front hurled broadsides of ponderous steel projectiles the turrets and forts, regarded as impregnable, crumpled like cardboard. The result was a resort to earth trenches and embankments. Why? Because the only resistance possible was that of absorbing the shock instead of defying it. The same principle dictates shock absorbers and pneumatic tires for automobiles and trucks to protect the vehicle and its load. Our streets and roads must withstand the bombardment of more than four million truck wheels. The shock absorber in this case is the asphalt wearing course whatever the base. Asphalt,—resilient, dustless, noiseless, waterproof, wearproof,—the pavement of Broadway, Fifth Avenue, Michigan Boulevard, Broad Street, and Pennsylvania Avenue, is the last word in modern pavement design and is no more costly than a rigid unprotected pavement.

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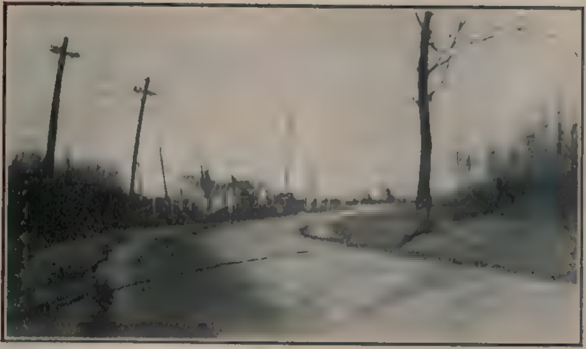
TAR ROADS



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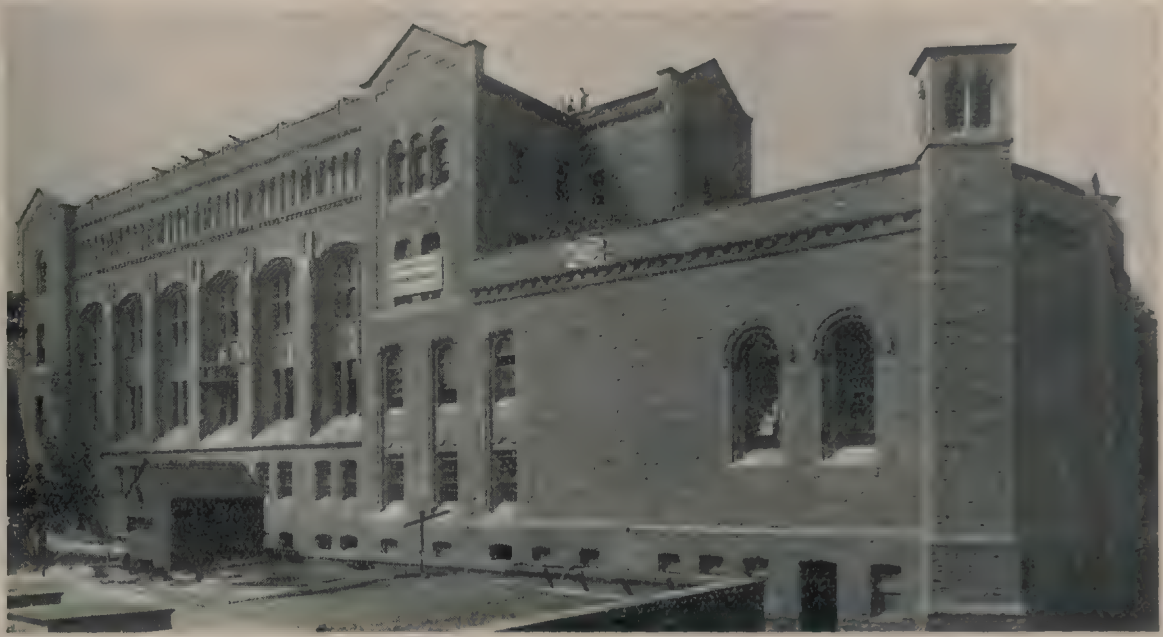

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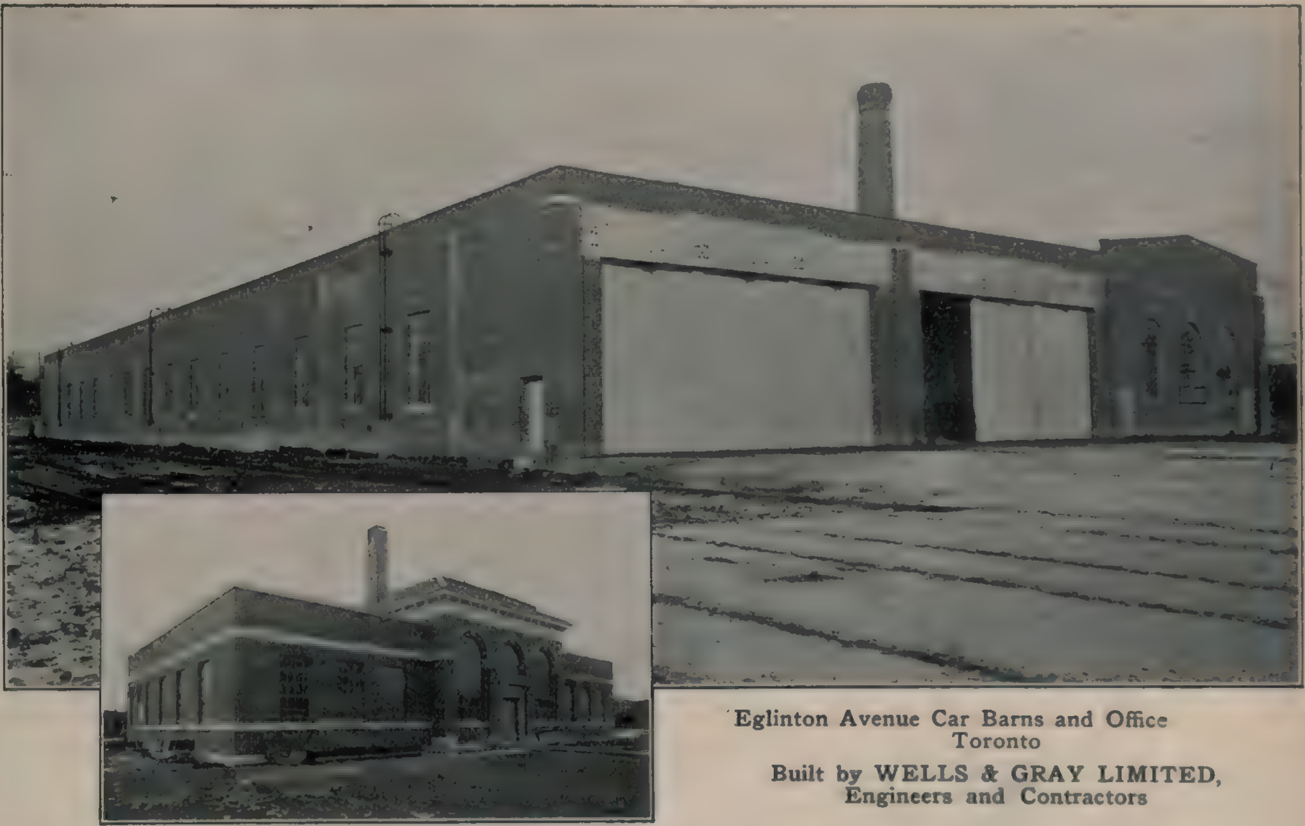

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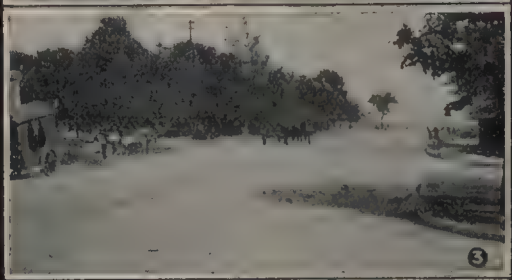
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AMONG the most interesting construction work of the past season has been the development of Sunnyside Beach, Toronto, under the direction of the Toronto Harbor Improvement Commission.

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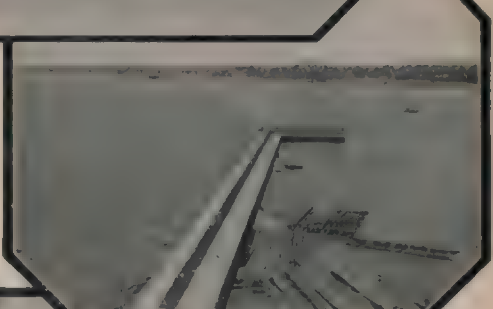

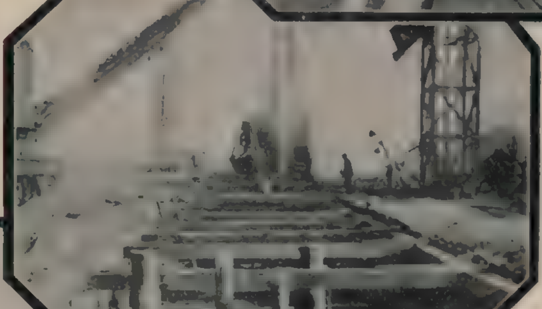

(1)—Travelling derrick handling 18 ton cement blocks for Western Breakwater, Toronto Harbor Improvement Contract.

(2)—Completed Breakwater protecting Sunnyside Beach, Toronto Harbor Improvement Contract.

(3)—View of work constructing foundation for tin plate rolling mills for Baldwins Canadian Steel Corporation, Ashbridge's Bay district, Toronto.

(4)—View of landing dock at Port Borden, P.E.I., in connection with the car ferry service between New Brunswick and Prince Edward Island. Constructed for the Department of Railways and Canals of the Dominion Government. Completed in 1917.

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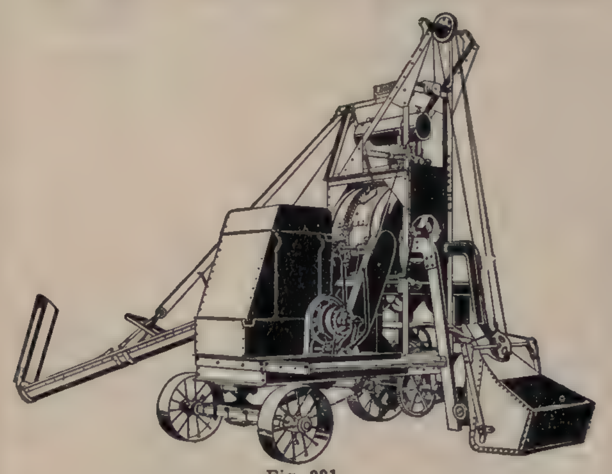

Fig. 801
LONDON SPECIAL SIDEWALK PAVER

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Have you a contract to build sidewalks or concrete roads to repair, then, either of the two London Special Concrete Mixers herein illustrated should form part of your equipment.

Fig. 801 illustrates The London Special Sidewalk Paver designed to travel along the roadway under its own power, building sidewalks and curbs. No wheelbarrow or carts required. The concrete spout delivers the mixed concrete right to the forms.

The drum is mounted very high allowing a steep grade to the 14 ft. chute which delivers the mixed concrete. The City of Winnipeg, which uses three of these machines, has demonstrated the advisability of laying sidewalks with these machines. They are also in use by a number of contractors on large work. This machine will pay for itself the first season on any large sidewalk contract. Full particulars on request. Send for Bulletin No. 49-L.

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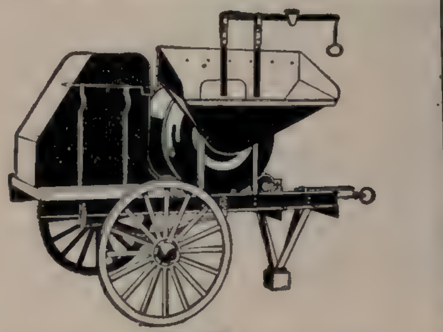

Fig. 808
LONDON REPAIR WORK MIXER

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ESTABLISHED 1886

Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada,
reaching Architects, Engineers, Contractors
Municipal Officials, etc.

Published Each Wednesday by

Hugh C. MacLean Publications
LIMITED

THOMAS S. YOUNG, Managing Director
HEAD OFFICE - 347 Adelaide Street West, TORONTO
Telephone A. 2700

Proprietors and Publishers also of Canada Lumberman, Electrical News, Canadian Woodworker and Footwear in Canada

MONTREAL 119 Board of Trade Bldg.
WINNIPEG 302 Travellers' Bldg.
VANCOUVER Winch Building
NEW YORK 296 Broadway
CHICAGO 14 West Washington St.
LONDON, ENG. - 16 Regent Street S.W.

SUBSCRIPTION RATES

Canada, Great Britain and British Possessions $3.00. U. S. $4.00. Other Foreign Countries $5.00. Single copies 15 cents.

Authorized by the Postmaster General for Canada, for transmission as second class matter.

Vol. 36 Toronto, December 27, 1922 No. 52

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Taking an Inventory—Our "Stock" is in an Excellent Shape

It's the usual thing to take an inventory at the end of each year's operations.

Good business methods demand that a comparison be made year by year of the progress being made. If we have done well it encourages us to greater effort; if badly, it warns us to search out and repair the causes of our inefficient operations.

The present issue of the "Contract Record" is, so to speak, an inventory of the Canadian Building and Construction Industry. It shows us what has been accomplished during the year 1922; it shows us where we stand in comparison with previous years' operations; it shows us where we have done well and where we have done badly; it points the way for a better year in 1923.

Speaking in a general way, the year just ending has been one of "watchful waiting." Except in rare cases there has been no evidence of a run-away volume of business or undue profits. On the other hand, there are apparently few lines of business where a fair balance is not shown on the right side of the ledger. Business has been what might be termed "fair" with indications that any change is for the better. There does not seem to be any objectionable factor looming up on the horizon to change the course of events. So far as any of us can see the gradual improvement will continue into, and through, next year.

In the construction field the outstanding item this year is "residences." Yet there seems to be no let-up to the demand. Neither is there any real evidence of a reduction in rental or in the prices of homes offered for sale. To all appearance the demand will continue through next year and building operations should be quite as brisk as they have been in 1922.

The next largest item is "roads." Canadians seem to have made up their minds that good roads are essential and that they will pay the price. This is especially marked in Ontario, where the programme already under way insures a continuation of the present year's activity. All indications are that, all over Canada, the demand for good roads will continue and the building activities will increase in volume as the years go by.

It is unfortunate that prices of materials and labor have not shown further recessions, but the big factor is Labor. This item enters so largely into the cost of every raw material, every manufactured article, every piece of construction work, every building of whatever size or for whatever purpose, that it seems almost hopeless to look for reductions in the cost of building materials until "Labor" concedes something substantial. There is still the demand for more intense effort, for less insistence on improved working conditions and more concentration on improved quality of product. "Labor" to-day is too selfish to be efficient. It may not be labor's fault, but that is the fact we must face. And selfishness never begets efficiency.

Our Annual Inventory! What Story Does it Tell?

Canadian Dollar at Premium the World Over—Grain Crop Practically Equal to High Record—Building and Construction Figures Over Three Hundred Millions —Export Trade per Capita Largest in World

A year ago, writing on the probable trend in general business, "Contract Record," analyzing conditions as they presented themselves to us at that time, expressed the opinion that there would be a steady but quite decided improvement during 1922. Looking back over the year we feel that our prophecy has been justified. There have been bad spots here and there, industries where the results of the year's operations are unsatisfactory, but in the main we are confident that the balance sheets of 1922 will make for a much Merrier Christmas and a Happier New Year than did those of 1921. Dividend increases have been common and in some cases quite enormous. Practically no dividends in listed stocks are now being passed while increased earnings and generally improved conditions are reflected in almost spectacular rises on the security prices of many of our industrials.

Thus, basicly, we are in a much more favourable position than a year ago. Instead of depleted treasuries we have comfortable bank balances; instead of fear and trembling we have hope and confidence; instead of the pressing need of economy and curtailment we are regaining our old desire for expansion by judicious expenditures.

Do Canadians, after all, fully realize the force of the favorable factors in our economic life, comparing our position today with a year ago? For example:

(1) On December 27, 1921, the Canadian dollar was at a discount of 6¼ per cent in New York having already recovered from a low of about 20 per cent. During the year our dollar has not only been at a premium in New York, but—let us not forget this—at a premium in every country in the yorld. When the pound sterling began its spectacular rise a few days ago, financial authorities ascribed the movement to the fact that Great Britain was making great progress in "setting her house in order." By the same line of argument we may conclude therefore, that Canada's house is already pretty well fixed up.

(2) Canada's 1922 wheat crop is approximately equal to the previous high record. There are those who tell us that this has no great significance on account of the low prices ruling at the moment, and it is doubtless true that the revenue from this year's crop will not clean up the Western situation entirely. However, it's a big step in that direction and it is certainly a most encouraging factor that in a bad year like 1921 when the farmers of the west, some of them, were hanging on by a thread, they still had the grit, the confidence and the material resources to sow the seed from which a record crop has this year been garnered. Another good harvest will bring our Great West back to normal. Optimism there was never dead; it was just resting for a time,—re-cuperating—and will be more in evidence than ever if it gets half a chance.

(3) Construction activity is again on the increase. This year's figures will total around three hundred million dollars. This is not the highest figure in Canadian history perhaps, but it is the largest since the beginning of the war. In very considerable measure this expenditure has been made on private homes and on public highways, the former of which were urgently needed to make good the curtailed operations of war years and the latter to supply a demand that is resulting from a new viewpoint our citizens have taken of life in general.

The house demand, even with our present population, is apparently almost as keen as ever and if, as the various movements in that direction would indicate, immigration is actively and consistently encouraged in the near future, this demand must increase; further, with our increased population will come increased demand for schools, churches and such public buildings.

As for good roads, the public have tasted them and no one doubts that our roads of the future will be constructed at a cost of billions of dollars.

In the wake of improved industrial activity and good annual profits will naturally follow the demand for factories, warehouses, offices and stores. With improving rural conditions the towns and cities will become more prosperous and much engineering work, now long delayed, will be begun.

(4) Another item having a very important bearing on industrial building is our increasing export trade. It will come as a surprise to many perhaps that Canada has the largest export trade, per capita, of any country in the world. This does not even except Great Britain and the United States. In 1902 our exports amounted to $28.00 per capita compared with $40.00 for the United Kingdom and $15.00 for the United States. At the beginning of 1914 Canada had increased her exports to $58.00 per head, an increase of 130 per cent., while the United Kingdom was up to $70.00 a head, an increase of 75 per cent., and the United States $24, or 60 per cent. By 1920 Canada had passed the United Kingdom and in the slump of 1921 held up much better than the other two. At the beginning of the year 1922 the figures were: $150 for Canada, $98 for the United Kingdom, and $65 for the United States.

Of course, Canada's grain crops accounts for a considerable portion of this, as well as certain other raw materials, but our export trade in manufactured goods has increased greatly in the past few years. This apparently has been Canada's safety-valve. Unable to absorb our manufactured products at home, on account of general depression, our manufacturers have been developing the habit of looking elsewhere for a market. This has had the double advantage of keeping our people and our industries occupied at home and of bringing extra money into the country at a time when it was most needed.

There may be those among us who still look upon Canada as primarily an agricultural country and who deprecate the effort to develop manufacturing industries. A resume of the amount of capital tied up already in these various industries will have the effect, we believe, of convincing the most skeptical that Canada is destined to be a great manufacturing country—in so far at least as the utilization of her varied and bountiful natural resources are concerned. Table 1, herewith, is extracted from figures recently supplied by the Bureau of Statistics, Ottawa, and published in the Financial Post ot December 1. It shows that the total investment in our various industries amounts to the considerable sum of $2,743,520,823.

The significance of this figure is better realized when we consider that it is approximately equal to our total national debt. Looked at from the other side, however, we also have an answer to those who would have us believe that we have mortgaged ourselves too close to our actual value. If our manufacturing establishments alone constitute, in themselves, sufficient wealth to wipe out our national debt then we still are solvent to the extent of everything outside of this—our agricultural areas, our forests, our mines, our water powers, our public utilities —everything indeed that does not fall under the one heading "manufacturing"—

Table—1 Capital Invested in Canada's Various Industries

The Lumber Industry (Mill Production)	$266,839,952
The Lumber Industry (Forest Production	441,007,844
The Pulp and Paper Industry	294,550,867
The Meat Packing Industry	188,005,025
Steel Furnaces and Rolling Mills	117,124,269
Copper Smelting (Including Some Lead, Zinc and Nickel)	111,921,977
Agricultural Implements	86,392,635
Foundry and Machine Shop Products ..	53,610,884
Electrical Apparatus	52,666,163
Cotton Textiles	51,425,480
Ship Building Industry	39,496,610
Drugs and Chemicals	33,171,464
Flour and Cerial Mills	34,406,807
Rubber Goods Industry	30,936,095
Rubber Boot and Shoe Industry	18,853,100
Fish, Canning and Curing	25,935,581
Patent or Proprietary Medicines	25,012,671
Woolen Textiles	24,905,270
Paint and Varnish Industry	23,965,858
Liquors, Malt	23,332,100
Asbestos Mining	23,308,100
Leather Boots and Shoes	22,121,609
Building and Construction	21,933,623
Hosiery and Knit Goods	19,955,548
Automobile Manufacturing	14,677,300
Artificial Abrasives	11,621,100
Liquors Distilled	11,199,800
Biscuits and Confectionery	10,524,328
Leather Tanning Industry	9,906,200
Automobile Accessories	9,820,603
Brass and Copper	9,234,606
Refined Petroleum	6,237,670
Car Construction	3,854,550
Condensed Milk	4,252,680
Sugar Industry (1919 Returns)	19,002,632
Total	$2,743,520,823

* * *

The four examples mentioned above do not by any means exhaust Canadian's reasons for optimism, but they seem to indicate definitely and unmistakeably that we are justified in entering upon a new year with a keen sense of security. They indicate in a general way that Canada is sound financially; that her future prospects are of the very best; and that she is known and esteemed the world over.

If such is our position today there is little need to discuss the possibilities of tomorrow. The only danger that could beset Canadians is that they should take too much for granted and relax their efforts. Such, however, is not the history of their past and neither will it be of their future.

We predicted a year ago that normal business conditions would not be reached before the spring of 1923 and that the summer of 1923 would probably be the best, from a general business point of view, for many years past. Now that we have the year 1922 behind us and can check up such a magnificent balance in Canada's favor there does not seem to be any reason to change that prediction. Judged inpartially by all the evidence at hand 1923 will be a better year than 1922.

How Business Men Appraise 1923's Industrial Prospects

Conditions in the Business World Are, to Some Extent, a Criterion Upon Which to Base Construction—Opinion is General That Next Year Will Witness very Considerable Improvement

What are the prospects for 1923 in the construction industry? That question is one that has an alluring appeal to those interested in building and contracting and yet it is one that of necessity is very difficult to answer. A concrete forecast is hard to present but it may be possible to give some clue to the amount of building that may be expected by analyzing business prospects for the coming year. To a certain extent business is a criterion upon which to base the volume of construction—if business is bad, so will building be, but if industry prospers, it may be assured that construction will be active also. With this idea in mind the "Contract Record" asked several well-known and representative business concerns to give their opinions on conditions and make a forecast of the prospects for 1923. A number of these views are printed below and it will be noted that for the most part they sound a very encouraging note and lead to the opinion that the volume of building next year will set a record.

10 to 15 Per cent. Improvement in 1923

Optimism is the spirit that is current in the mind of R. H. Combs, general manager of the Canadian National Carbon Co., Ltd., Toronto. His letter suggests a continuance of satisfactory business conditions with the possibility of considerable improvement. Mr. Combs writes:

"1922 has been a very satisfactory year from every angle. The demand has only slightly improved over last year but it has been steady and continuous which has made production go along at a steady, even rate, resulting in improved manufacturing as well as marketing conditions and we believe that general fundamental conditions on which business hinges in Canada, promise a continuance of this satisfactory business, with perhaps 10 to 15% improvement in 1923."

Next Year Even Better Than This Year

No curtailment of construction is anticipated by the E. B. Eddy Co., Ltd., Hull, P.Q. According to their letter, which is signed by John F. Taylor, the secretary of the firm, they are hopeful regarding 1923 prospects and expect better conditions than during 1922. The letter is as follows:

"We are optimistic as to future business, and we feel that 1923 will be still better than 1922. As regards construction, this year's figures as you already know show up pretty well, particularly when you embrace all kinds of buildings. We feel that construction work during the coming year will not be curtailed, and that if anything, next year should be even better than this year.

"In so far as the building of our new match factory is concerned we have decided not to do anything further about the matter, that is, for the present at all events and until such times as we succeed in getting our assessment straightened out with the city."

1923 Will be a Good Building Year

A construction program of considerable dimensions is being carried out by Imperial Oil Ltd., according to a letter which the president of the company, Mr. C. O. Stillman, has written to the Contract Record. The outstanding project is the two and a half million dollar refinery at Calgary. Speaking of construction generally, Mr. Stillman considers that 1923 will be a great building year. His complete letter follows:

"Replying to your enquiry in regard to the prospects of business expansion during the coming year, I can only cite a new refining project that Imperial Oil Limited has under way at Calgary, Alta., involving an expenditure of approximately $2,500,000. This refinery completes the chain of manufacturing establishments which extends from coast to coast, and which is intended to provide for the needs of Alberta, the province of Saskatchewan being served by the Regina refinery, and Vancouver by the Vancouver refinery. The plant will provide employment for several hundred men.

"For a number of years our expenditures upon drilling operations, amounting in the aggregate to several million dollars, have been a considerable factor in the employment situation in the west, and we will continue these operations throughout 1923. Otherwise our construction program for that year includes only the erection of service stations at various centres, and the ordinary extensions of plant to meet changing trade at a number of points.

"Generally we would consider that 1923 would be a good building year. The construction program of this country would be much further ahead had there existed any general movement towards a reduction of building costs.

"By comparison this country is a favored spot, but we have large obstacles to overcome, and perhaps our greatest ground for confidence in the future is that we have emerged from the effects of the war with no more serious mishaps than have occurred."

1923 Should be Fairly Satisfactory

The Canadian General Electric Co., Ltd., Toronto, expects continued improvement in business conditions during 1923. J. J. Ashworth, the general manager, reports as follows:—

"Business conditions are somewhat better than they were during the latter part of 1921 and the early months of 1922, and if the improvement which is now in evidence continues the year 1923 should be fairly satisfactory."

C. P. R. Non-Committal

Grant Hall, the vice-president of the Canadian Pacific Railway Co., is non-committal, as he does not feel that the time is ripe in which to venture an opinion as to next year's prospects. He writes:

"It is too early yet in my judgment to make anything like a reasonable size-up of the situation for next year. We must see how the marketing of the very large grain crop in Canada will react upon business conditions generally before a proper opinion could be expressed."

Prospects Are Encouraging

The Canadian Car and Foundry Co., Ltd., Montreal., express their opinions of the future in terms of their own business and report that the prospects are encouraging. Mr. S. Whyte, vice-president, writes in this connection as follows:—

"The only conditions we have encountered and which have adversely affected our industry, so far as I can see, are lack of orders.

"Both domestic and export markets for our products throughout the year have been practically stagnant, the general trade depression which was carried over from 1921 continued throughout the greater part of 1922 and the Canadian railways generally did not come in the market for any large quantity of equipment, while owing to the disturbed state of European finances, it was not possible to develop any export trade. There has, undoubtedly, been a general improvement in business in Canada and it is anticipated that as a result of this the Canadian railways will have to purchase additional equipment; therefore, the prospect for 1923 is encouraging."

Readjustment Will Come

It is always interesting to have the ideas of the banking and financial institutions regarding business conditions, for it is generally considered that they are in such close touch with the situation as to be able to express opinions that are a result of a sane and logical outlook on affairs and an intimate knowledge of conditions. For this reason the following comments of Sir Frederick Williams-Taylor, general manager of the Bank of Montreal, are of interest:

"It is trite, yet undeniable, to remark that in Canada, as elsewhere, trade generally has not been good. Bankers, more distinctly than others, perceive the detailed results of this condition, which in large measure is brought home to them through losses and diminished profits.

"Canada's economic position is not satisfactory. How could it be satisfactory, with the whole financial world out of joint? As everyone is aware, our troubles are partly the result of this universal condition; partly the result of the war. It is well, however, to bear in mind that our problems are largely of our creation.

"Readjustment will come in time, for this is a country of virility and manifold resources; yet one thing stands out signally, in my opinion, namely, that Canada cannot go ahead again as she should while taxation and the cost of living are higher in this country than they are in the United States of America.

"Canada is one of the best countries in the world to live in, to work in, to play in,—in point of stability, security and comfort it is an earthly paradise as compared with Europe—but we must not stand still, and in order to progress the cost of living and taxation must be diminished; otherwise, we will fail to attract immigration; and improved conditions are largely dependent upon increased population.

"As to ways and means, they are obvious to all who reflect, and the necessity thereof is now being brought home to the heedless by that pitiless but unerring teacher, necessity.

"The past half year has witnessed many fluctuations in the foreign exchanges. The most important for us is the rapid decline in the value of New York funds, which have fallen from the high point of 19% premium in December 1920, to a slight discount at this date. The decline would have been greater but for Canada's imports of gold from the United States of America.

"We must congratulate ourselves on this state of affairs; yet we must not lose sight of the fact that it is brought about not so much by the improvement in our trade balance, although that is considerable, but more through the sending of special large sums into Canada and by heavy borrowing in New York on the part of federal and provincial governments, municipalities and industrial corporations, borrowings which have been extraordinarily easy, owing to a plethora of funds in the New York market.

"We cannot, therefore, look upon our present position as permanent, and should be prepared for the possible return of the premium on New York funds.

"Since January, sterling has ruled at higher rates and has been much steadier, moving within the comparatively narrow limits of $4.35 and

$4.58 to the pound. The higher and steadier rates have tended to offset to some extent the fall in prices of our provincial exports to Great Britain, and less violent fluctuations have reduced the risk in forwarding commitments."

The Canadian Manufacturers Association has also conducted an enquiry relating to business conditions and the reports received are very encouraging. These are printed in the Association's official organ, "Industrial Canada," from which a few of the opinions are reprinted below as bearing out those expressed in the previous letters:

Business Constantly Increasing

The Schultz Brothers Co., Limited, Brantford, manufacturers of sectional buildings, boxes, woodworking products, sand, lime, brick, etc., state that business in all branches has been consistently increasing, 1922 to date exceeding in volume same period of 1921, with marked increase in boxes and sectional buildings. The necessity for a new plant is being felt.

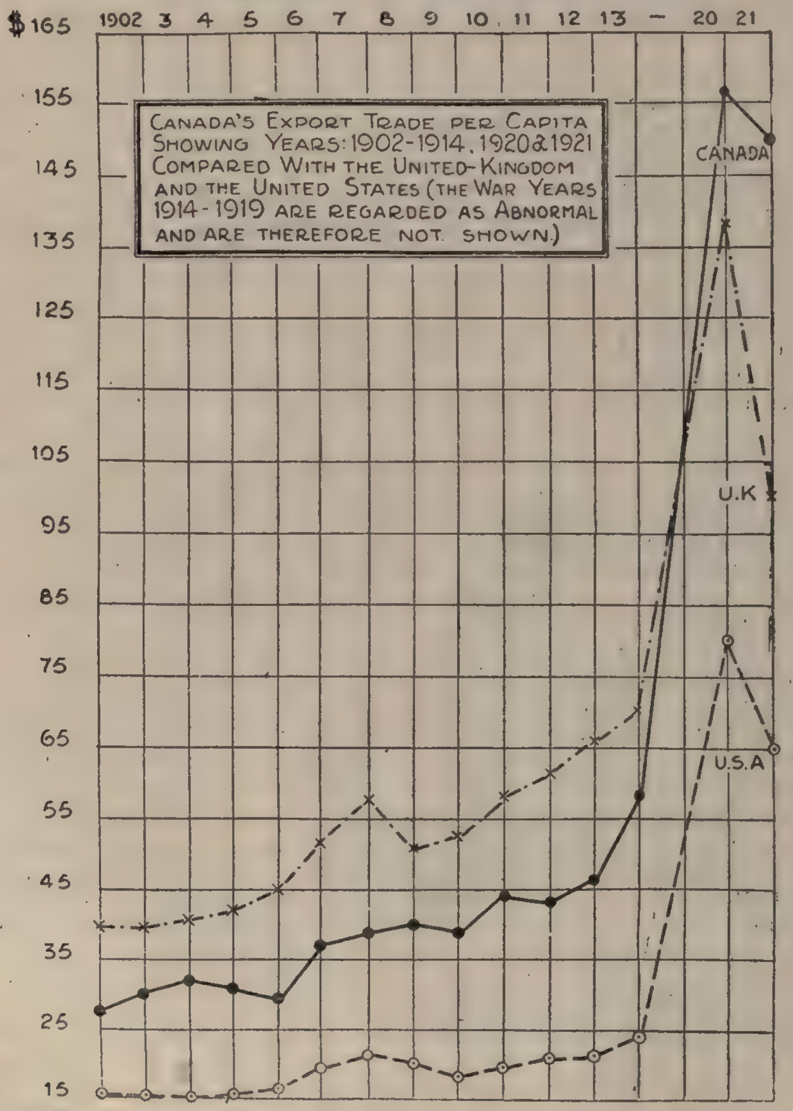
Automobile Business Prospering

An indication of the prosperous condition of the automobile manufacturing industry is found in the report of one of the Canadian companies, who stated that business this year has been considerably ahead of last year, which in turn was 40 per cent. over 1920. They are planning a considerable increase in their production schedule for 1923, to take care of the increasing demand under the British preferential tariff arrangements.

Exceptionally Busy

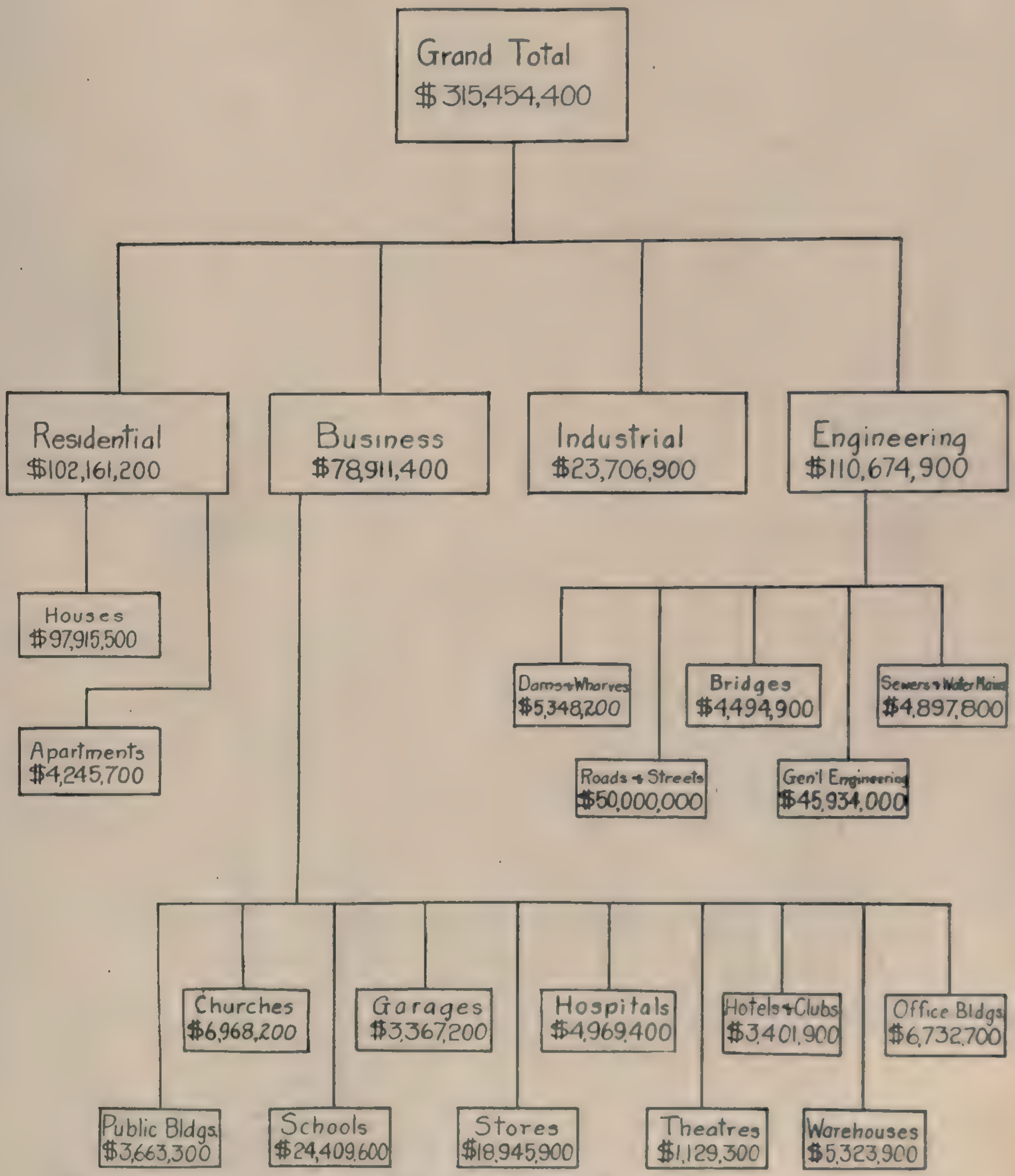
The Preston Wood Working Machinery Co., Limited, Preston, state that they have been exceptionally busy for the last three or four months and conditions look good with them until at least the end of year. They are gradually taking on more hands and are working full time.

An Indication of Canada's Soundness—The Superiority of her Export Trade



Canada's Building and Construction During Nineteen Twenty-Two

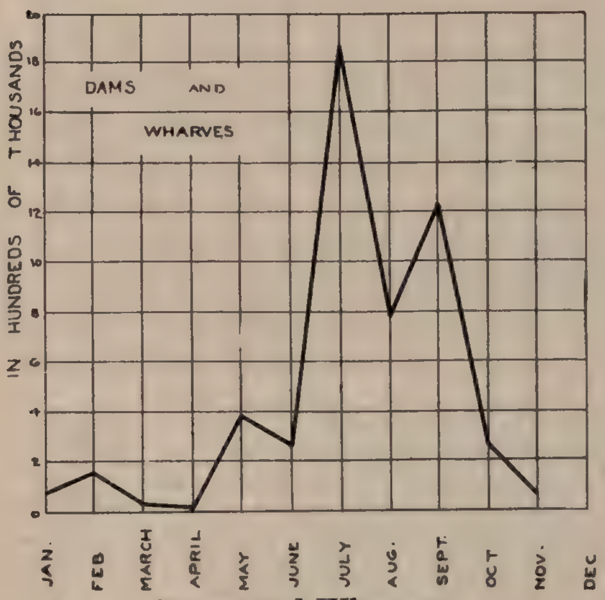
On This and the Following Pages a Series of Illuminating Graphs Tell the Story of a Year of Wonderful Progress in Many Lines of Activity



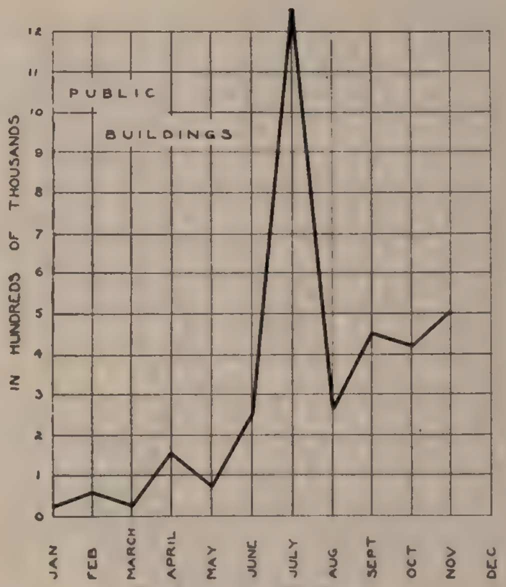
The distribution of the $315,454,000 spent on construction this year

Building

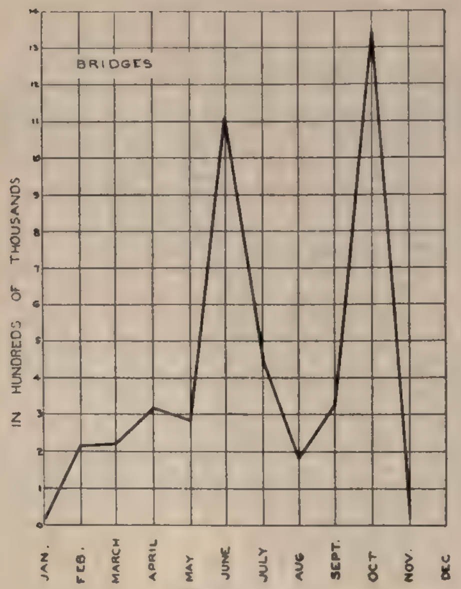
Work Undertaken Month by Month During Nineteen Twenty-two



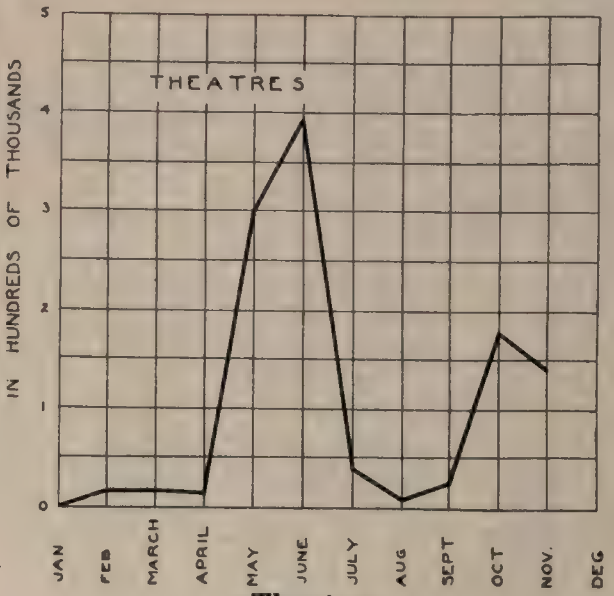
Dams and Wharves



Public Buildings



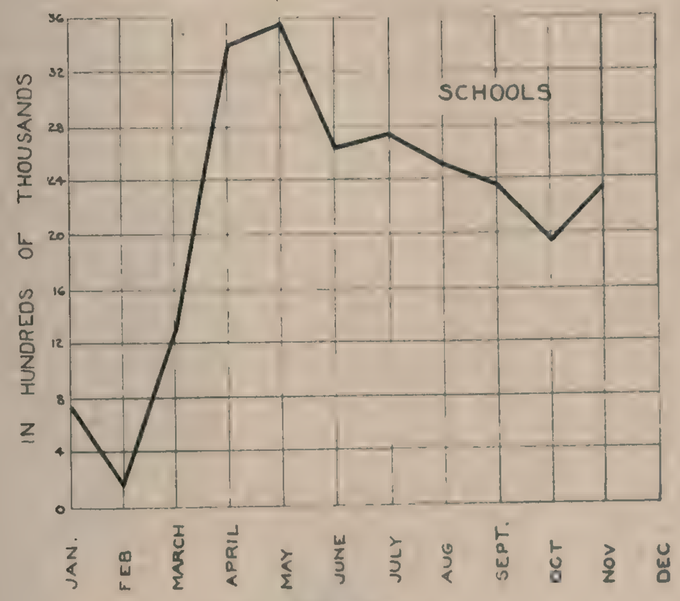
Bridges



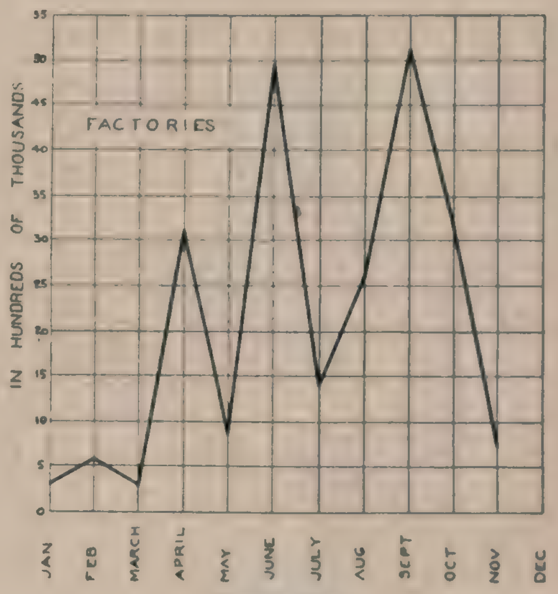
Theatres

Construction

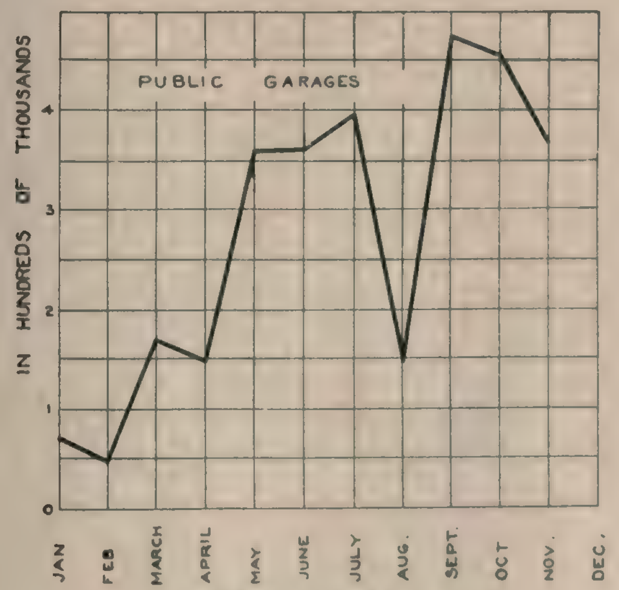
Work Undertaken Month by Month During Nineteen Twenty-two



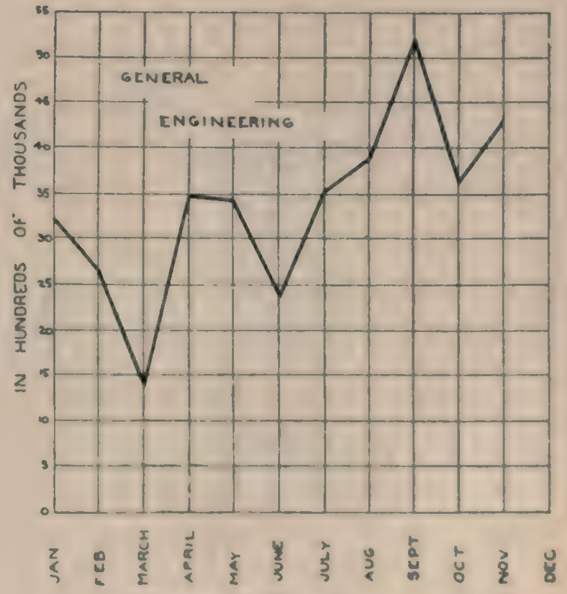
Schools



Factories



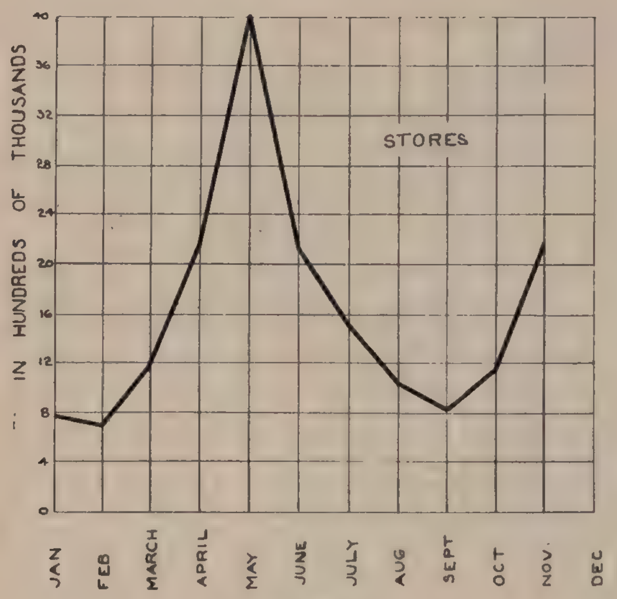
Public Garages



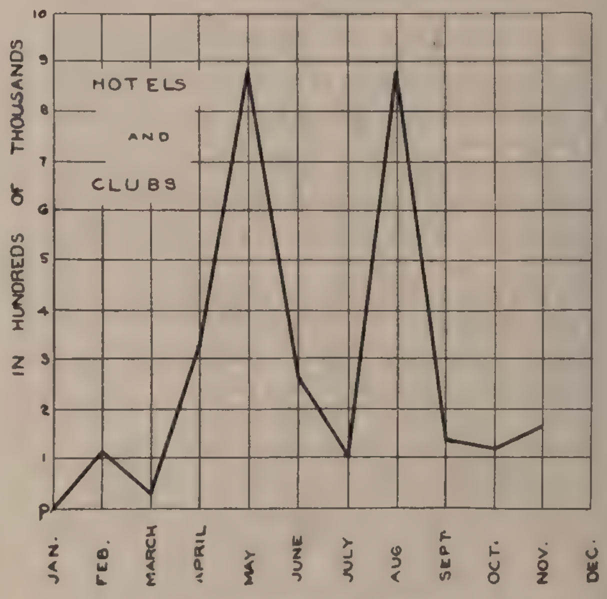
General Engineering

Building

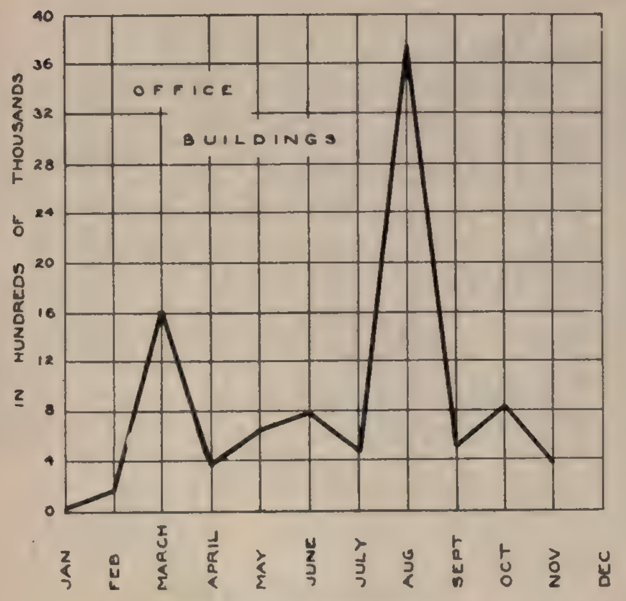
Work Undertaken Month by Month During Nineteen Twenty-two



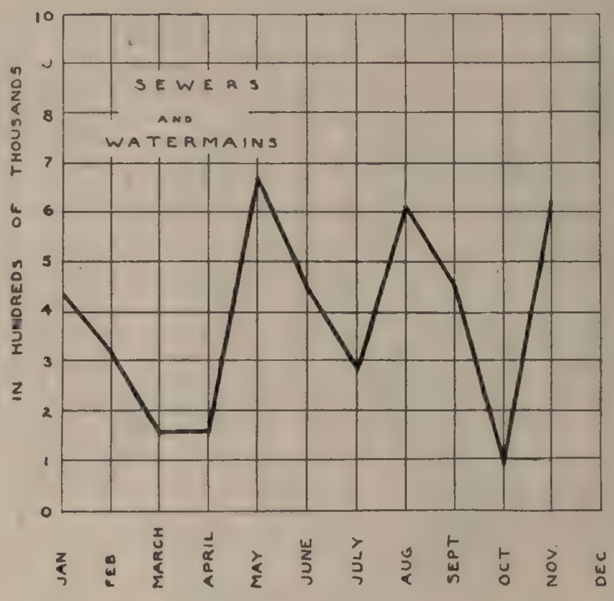
Stores



Hotels and Clubs



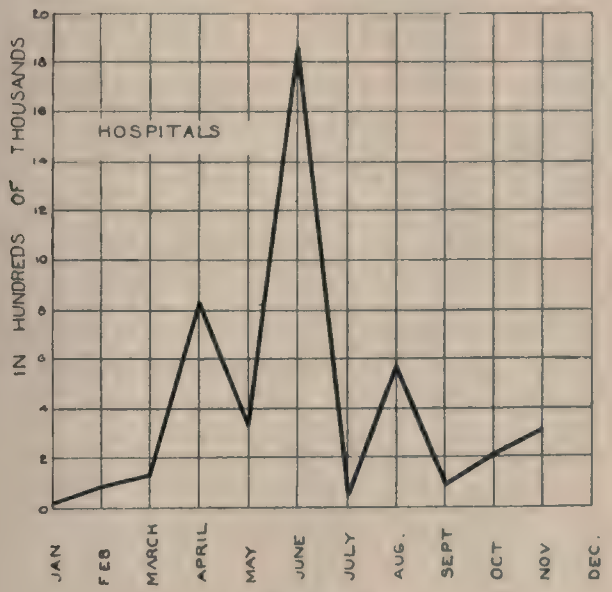
Office Buildings



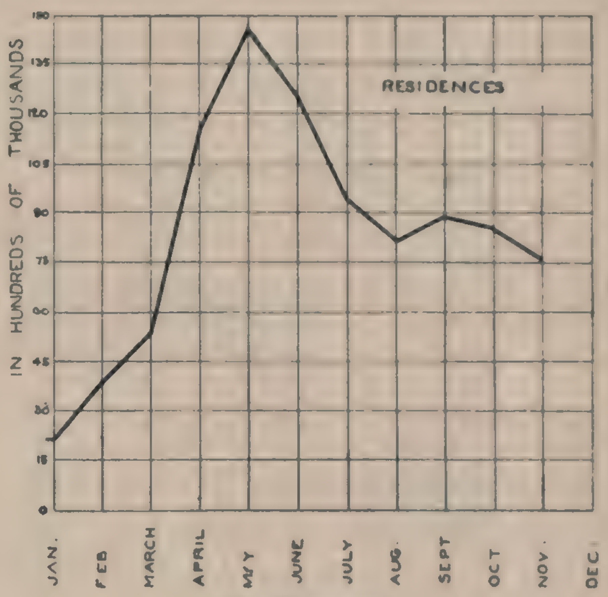
Sewers and Watermains

Construction

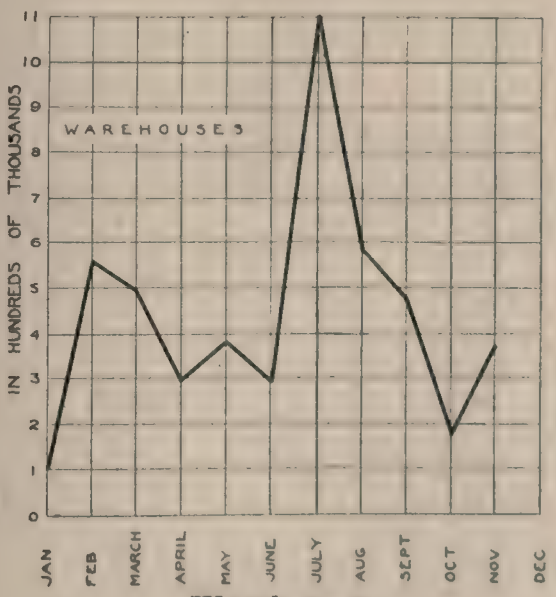
Work Undertaken Month by Month During Nineteen Twenty-two



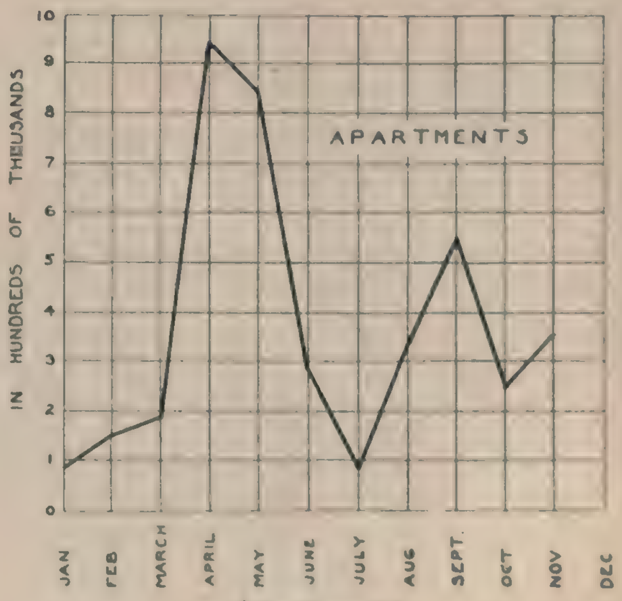
Hospitals



Residences



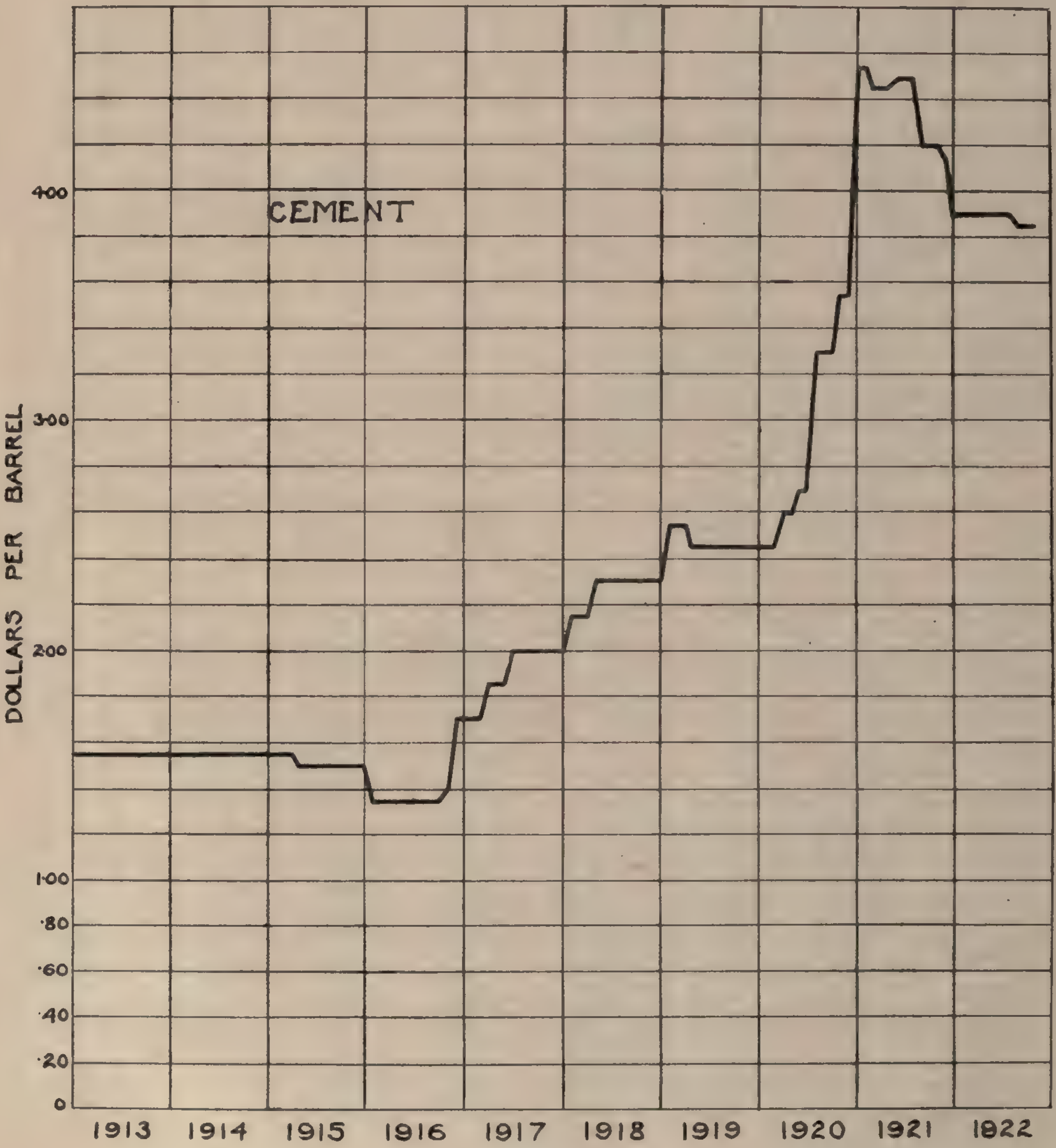
Warehouses



Apartments

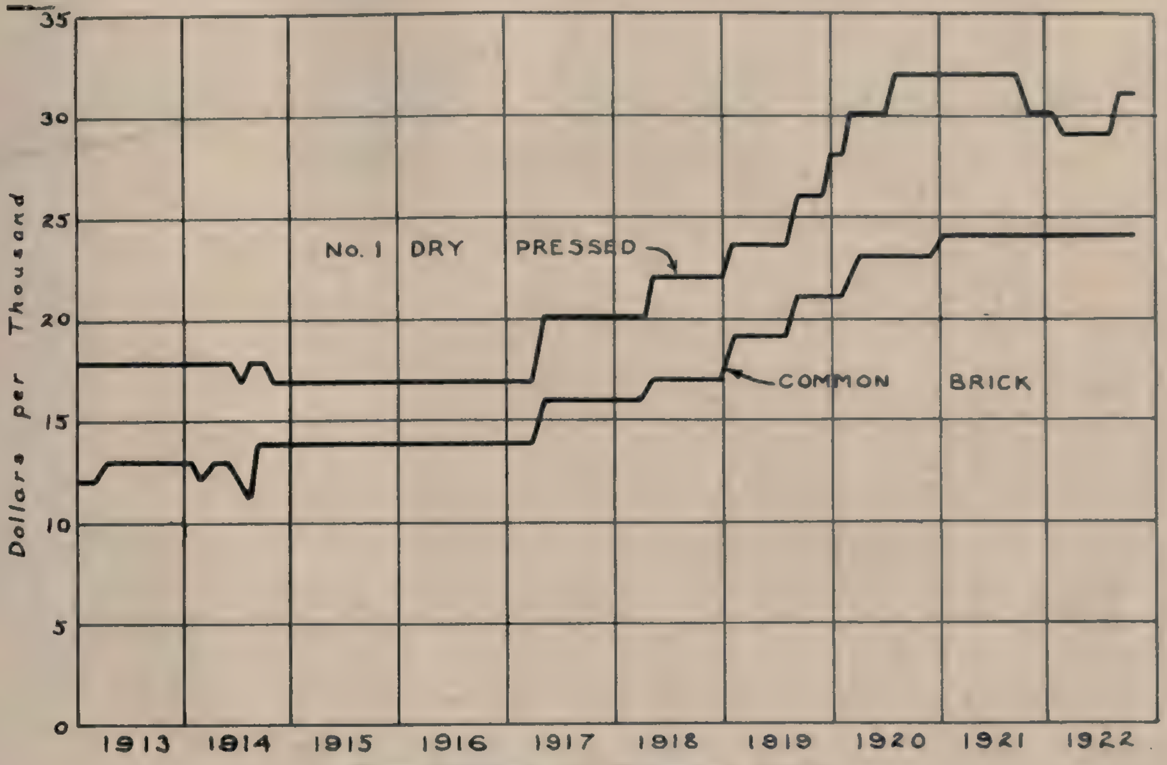
Building

Trend in the Prices of Building Materials Month by Month from 1913 to 1922

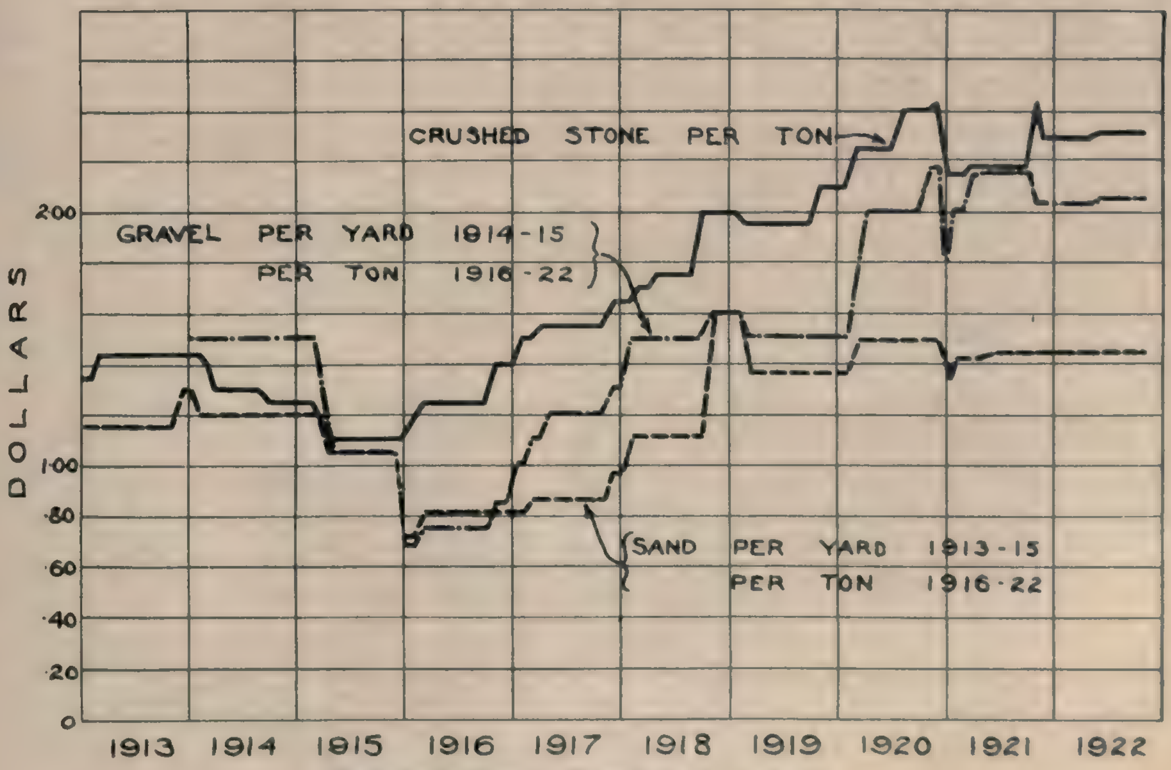


Cement

Construction



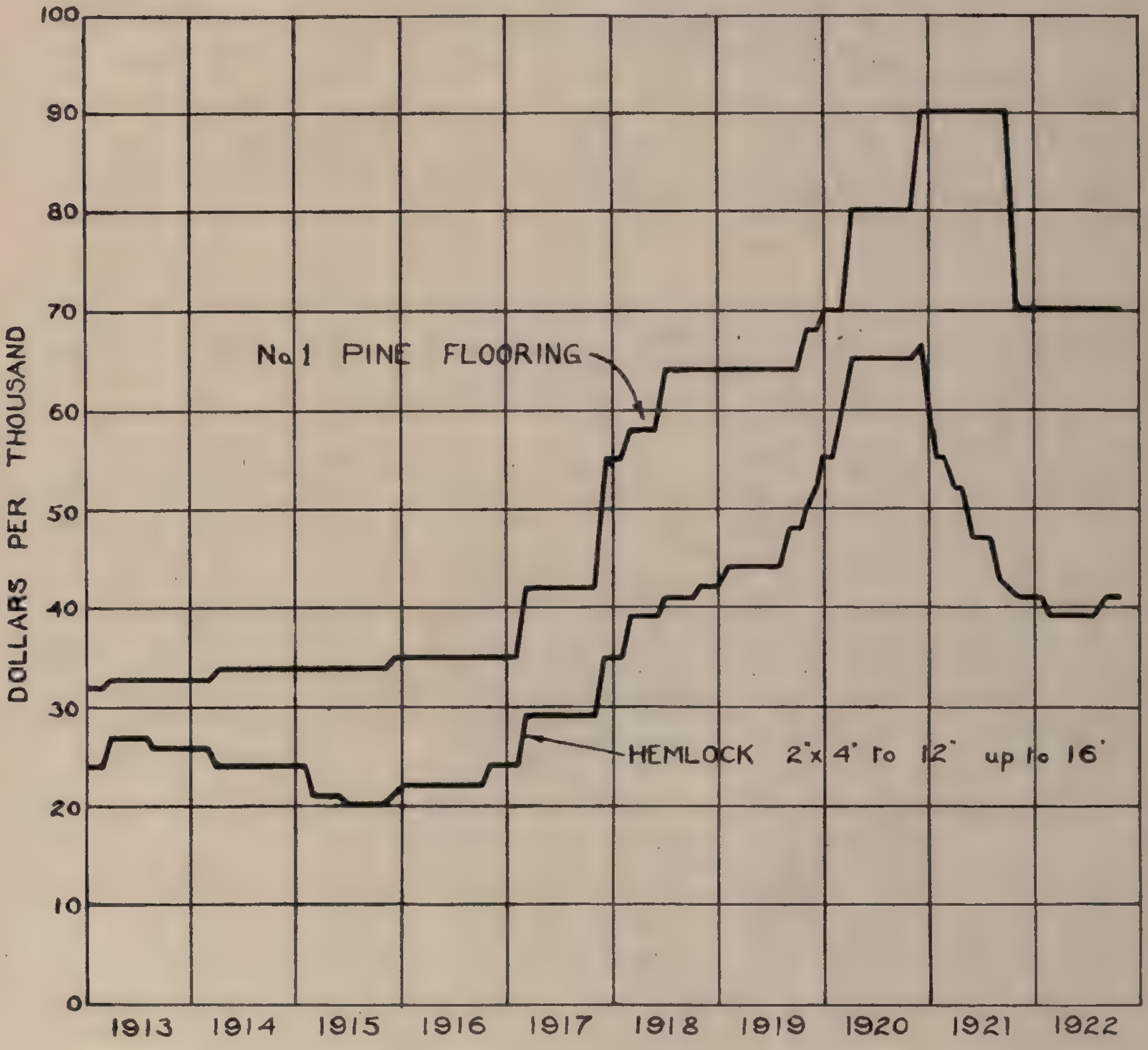
Dry Pressed and Common Brick



Crushed Stone, Sand and Gravel

Building

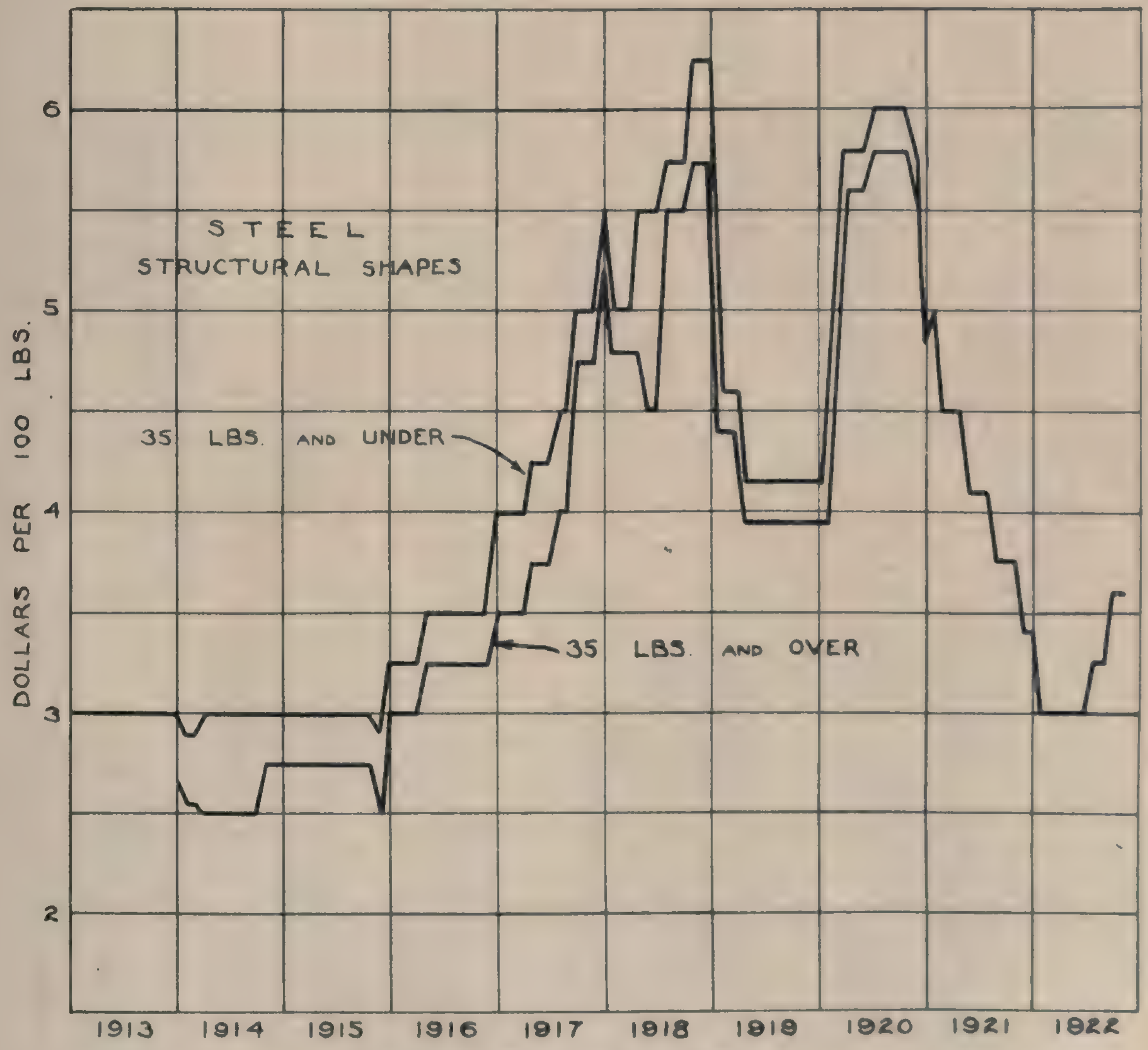
Trend in the Prices of Building Materials Month by Month from 1913 to 1922



Structural Steel

Construction

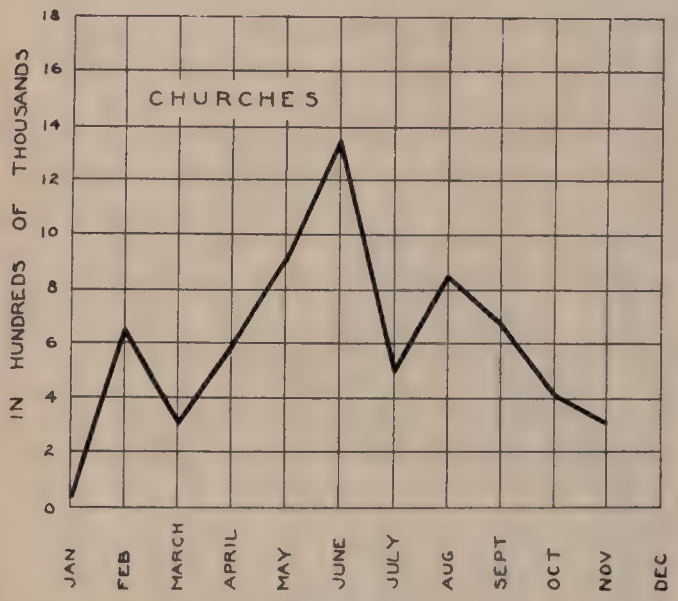
Trend in the Prices of Building Materials Month by Month from 1913 to 1922



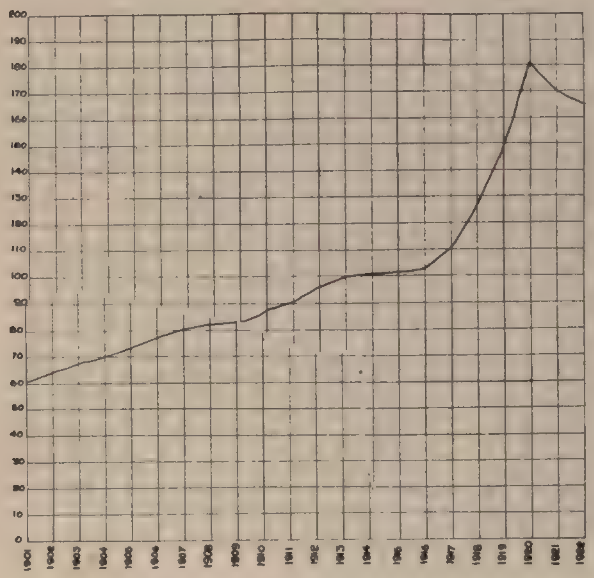
Lumber—Hemlock and Pine

Building

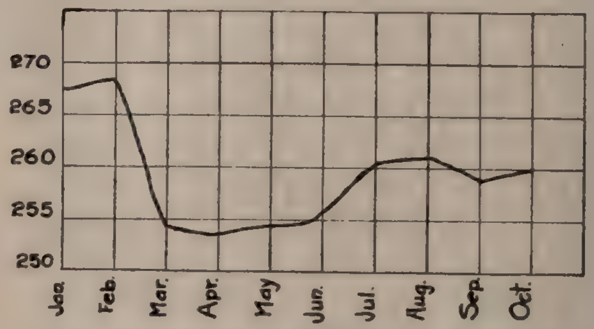
Miscellaneous Curves Showing Trend in Cost of Labor and Materials



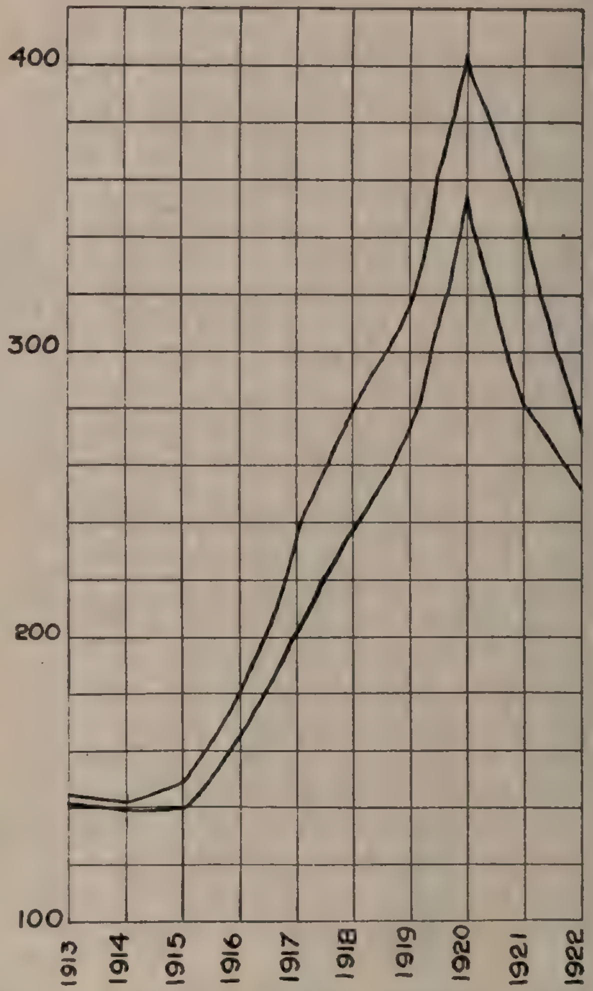
Churches



Hourly rates of labor in Building trades, average of seven classes, 1901 to 1922 inclusive—Year 1913 taken as 100



Price variations of 48 Building materials during year 1922. Average price 1890 - 1899 taken as 100



Price variation of 48 Building materials. High and Low monthly average for years 1913-1922. Average price 1890 - 1899 taken as 100

Anatomy Building, University of Toronto

A Structure of Handsome Appearance, Carried Out in Domestic Stone With Sandstone Trim—Interesting Foundation Conditions—Several Special Features of Design

The University of Toronto has just taken over from the contractors the new Anatomy Building, which is one of the most interesting of the whole University group. It is especially attractive in design and the lines of its architecture are most imposing. With its handsome exterior of Credit Valley stone, beautifully blended with the Briar Hill sandstone trim, it is a building of most distinctive appearance, quite in keeping with other buildings that form the group comprising the University of Toronto.

The Anatomy Building, which measures 208 feet 6 inches by 65 feet, except at the north end, where it narrows to 60 feet 6 inches, is laid out as follows: The basement contains storerooms, receiving room, embalming room, animal room, aquarium and several operating rooms. The ground floor includes the anthropology laboratory, a large lecture hall, besides locker rooms, demonstration rooms and miscellaneous quarters. The first floor contains special laboratories, museum, lecture room and two demonstration rooms, while the second and third floors contain various dissecting rooms, research laboratories and the necessary cloak rooms, toilets, etc.

The building was erected on the site of the old University Creek on filled-in ground. For this reason the foundations of the building presented an interesting problem, inasmuch as firm clay was reached only after excavating for a considerable depth. The building is carried on 91 reinforced concrete columns, all carried down to solid ground. The depths to which they were carried down vary very widely. Continuous concrete beams, below ground and spanning the columns, carried all the walls, both interior and exterior. Another interesting feature in connection with the sub-structure is a smoke breaching of concrete, lined with fire brick, running crossways under the basement floor. This breaching, which measures 9 ft. by 10 ft. 6 in., is designed to connect the central power house to the east of the new building, with a new stack, which will be located on the west side. This breaching is 19 ft. 6 in. below ground level. It is worth noting that although the foundation work was carried out during the fall of the year, practically no difficulties were encountered in the way of slides or water flooding.

The unexposed parts of the building and all interior walls are of brick above the concrete foundation. The floors are all reinforced concrete, designed on the beam and slab system. In general they are finished with Mastic. The exterior walls, except on unimportant facades, are faced with domestic Credit Valley stone, the trim and dressed stone being of variegated buff sandstone from Briar Hill. The appearance of the building is very much enhanced by reason of the splendid matching of the domestic stone with the dressed stone and by the smooth, delicate texture of the facing. The lecture room on the first floor, which measures 55 ft. by 49 ft. 9

The Anatomy building, the latest addition to the University of Toronto group in., inside, is interesting from an engineering point of view, on account of two large girders carrying the roof. These are of reinforced concrete about 7 ft. deep, cored out to reduce the weight. Further details regarding this interesting feature of the work will be given in a subsequent article.

The lighting of the disecting rooms on the top floor is done by means of saw tooth roof.

About 1,500,000 brick were involved in this job and 2,500 sq yds. of domestic stone facing, obtained from the quarries of F. Rogers & Co. The dressed stone for trim was furnished by George Oakley & Sons. Ltd. H. N. Dancy & Son carried out all the masonry work, the Crescent Concrete Co., all the concrete work and W. H. Thompson, the excavating. Plastering was done by Andrew Petrie. The steel sash was supplied by the Canada Metal Window & Steel Products, Ltd., and the saw tooth lights were supplied by Henry Hope & Co. (Canada) Ltd.

The work was started on September 1, 1921, and was taken over by the University of Toronto on November 1, this year.

Features of the Cement Market

Sales During 1922 Greater Than in the Previous Year—Indications are That Demand Will Increase Next Year—The Factors That Affect Manufacturing and Marketing

By H. S. VAN SCOYOC
Canada Cement Co. Ltd., Montreal

The manufacturers of cement, of neccessity, have the same difficulties to overcome that are associated with any seasonable product. These difficulties are accentuated in Canada on account of the comparatively short out-door building season that is usually experienced. This means the providing of very large storage space to carry the large stocks of finished products over long periods and the providing of shipping facilities entirely out of balance with operating capacities.

In Canadian mills it is customary to provide storage for approximately one-third of the annual capacity of the plant. The maximum daily shipping capacity is approximately three times the average daily manufacturing capacity. A very high percentage of the yearly shipping occurs during five months of the year. Efforts are being made to encourage the lengthening of the construction season. There is improvement, but still much to be desired if the shipping curve is to approach any way near the horizontal line.

Fuel & Freight

The industry is one of the very largest users of coal as fuel. The securing of adequate quantities of coal has been and continues to be a very serious problem. Prices for coal are still very much above what was formerly considered a normal price. At times no fuel has been available at any price.

Freight enters very largely into the delivered price of this product. Rates are still one hundred per cent higher than they were in pre-war times. This high freight rate enters not only into the delivered cost of the finished product but also enters into the cost of the fuel supply which enters into the manufactured cost of the finished product.

Duty on many of the materials and machinery entering into the construction of cement mills makes the initial plan outlined considerably higher per barrel of capacity than is the case in the United States. The long distance from the mines and the corresponding high freight rates add very much to the cost of the fuel.

The cost and efficiency of labor has shown marked improvement during the year 1922. Taxes, however, are away out of proportion to what they were a few years ago.

Unfortunately the greatest demand for cement during 1922 occurred at the same time that the grain movement in the West was at its height. This led to a very severe car shortage extending over a period of about six weeks.

The sale of cement during 1922 was greater than in 1921 and in fact was greater than had been anticipated. Residential building was carried on to a much greater extent than in any recent year and industrial building was somewhat better than in the proceeding year.

From present indications practically all of the difficulties which beset the manufacturers in 1922 will be present to the same or to a greater extent in 1923. Our present belief, however, is that the demand in 1923 will show a slight increase over that in 1922.

The Public School Board of Humber Bay district, Toronto, has arranged for the construction of two new school buildings, instead of one as originally projected and have retained Walker and Gibson as the architects and engineers. A new six-roomed building is to be erected fronting on Frederica street and a four-roomed building is to be built on Grand Ave. in the western part of this section.

A construction view of the cold storage plant of the Montreal Harbor Commissioners

A Massive Cold Storage Warehouse

The Montreal Harbor Commissioners Have Completed One of the Largest Buildings of Its Kind in the World—A Unit in the Scheme for the Development of the Port Facilities of Montreal

By the Contract Record's Montreal correspondent

The Montreal Harbor Commissioners' cold storage plant, situated at the foot of Beaudry Street, Montreal, Que., on the St. Lawrence River, is an important addition to the harbor facilities of that port. The necessity for such a plant has long been felt as a building of this character is an essential feature of up-to-date ports. To meet this need the Harbor Commissioners have completed one of the finest undertakings of its kind in the world which is not only of immense value to the harbor of Montreal but is of national importance to Canada.

The storage plant consists of two buildings: the warehouse where food products in the form of fruits, vegetables, eggs, butter, cheese, meats, etc., are received, stored in proper refrigerating rooms until shipment is required; and the power house where all the mechanical equipment for the cooling and maintaining of even temperatures in the various cold rooms of the warehouse is installed.

Huge Capacity

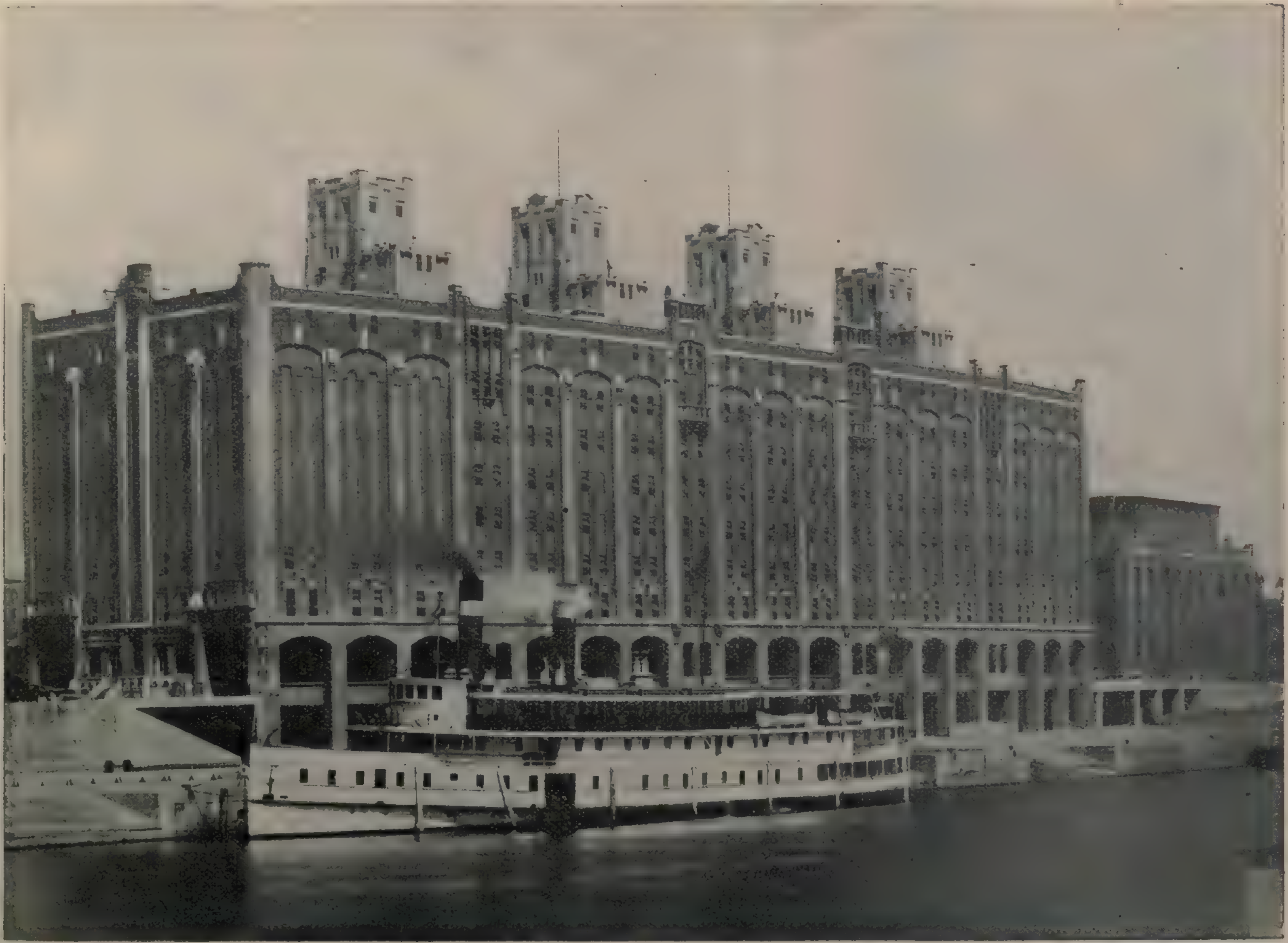
The buildings are quite impressive though built along simple vertical lines, the reinforced concrete outer columns being allowed to project slightly in front of the brown and yellow brick curtain walls. This gives a very handsome appearance, especially to the warehouse, of which the approximate dimensions are 446 by 100 feet in plan, with nine storage floors and considerable cellar space. The building is thus sufficiently tall and massive to carry to advantage this type of design.

To support this massive cold storage plant it was found necessary to contract for about 3,000 foundation piles, each to carry a load of 40 tons. This work was carried out by the MacArthur Concrete Pile and Foundation Co., of Montreal, who agreed to drive 750 lin. feet of piles per day to a refusal of 1 in. to 15 blows of a No. 1 Vulcan steam hammer. This contract rate was exceeded.

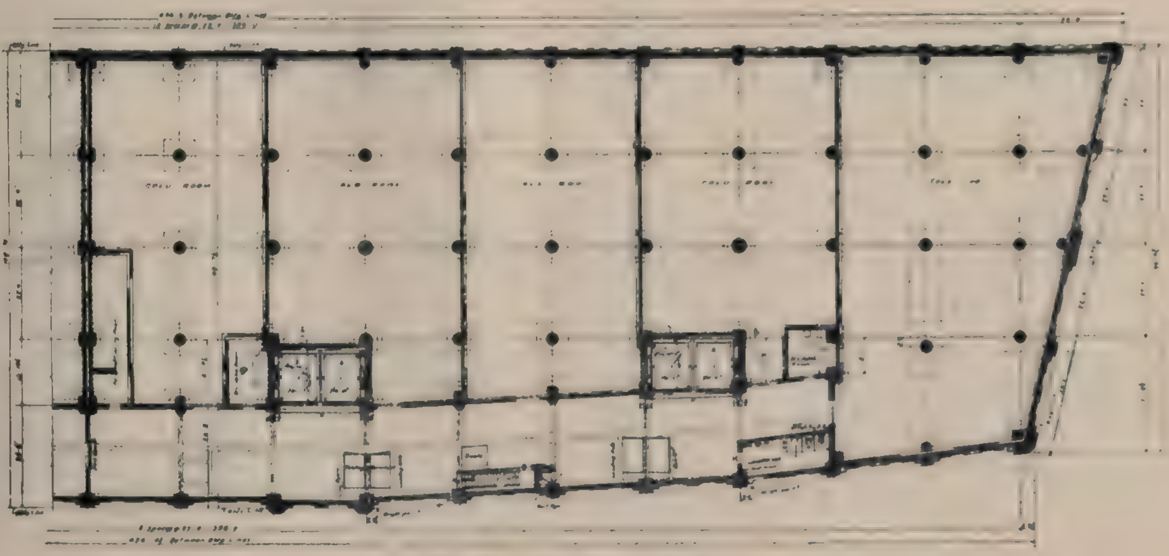
The Warehouse

The unusual shape of the warehouse on the south and east is due to advantages gained by conforming to an existing retaining wall between the upper and lower wharf levels at this point, the retaining wall serving to keep the water from the basement when the St. Lawrence River overflows the low wharf level in the spring. Since the high water level sometimes very closely approaches the track level, it was found necessary to make the junction between the basement and retaining walls watertight and provide a suitable slab continuously between footings to resist water pressure. For this purpose a good dense concrete about 14 in. thick was used, and to catch any possible leakage

A $2,500,000 Building—Important Addition to Montreal's Shipping Facilities



The cold storage warehouse recently completed by the Montreal Harbor Commissioners



Plan of a typical floor (east half)

suitable sumps and electrically operated pumps of ample capacity have been provided in the basement.

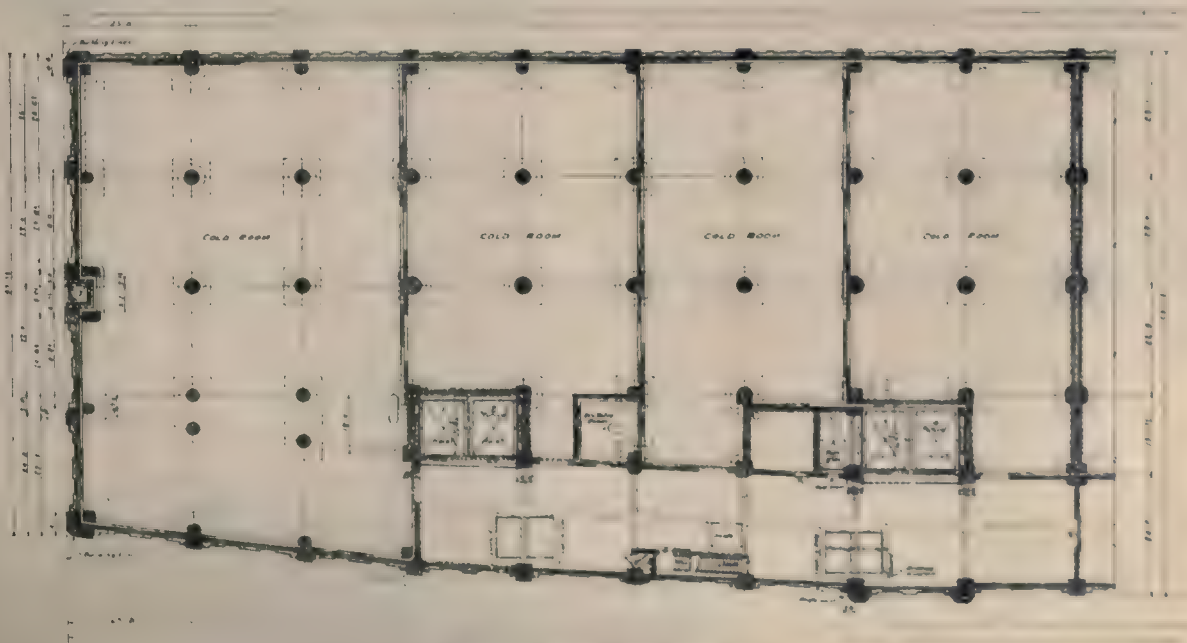
An adjunct, necessary even to a cold storage warehouse, is situated in the basement in the form of two Victory boilers equipped with a steam vacuum heating system providing heat to the second, third, and eighth floors and the distributing corridors of the cold storage floors, as there is always space for certain goods which need not be kept at very low temperatures.

The warehouse above the second floor is divided into three isolated sections, namely, the cold rooms of the west half of the building; the cold rooms of the east half; and the corridors and hoist shaft on the south, which have been made structurally independent of each other except for their common support at the second floor. This has been done in order to carry the insulation completely around the refrigerated portions and thus prevent heat conduction from portions of the building which may be heated.

Flat Slab Construction

The floors of the warehouse are of flat slab construction, with two-way reinforcement, are carried by concrete columns and are quite independent of the surrounding walls. The basement and first floors are each designed to carry a live load of 500 lbs. per square foot, the second and third floors, 350 lbs.; the fourth, fifth, sixth and seventh floors, 250 lbs.; and the eighth floor, 400 lbs. Only on the first floor and the corridor floors can be found any beam and slab construction.

One of the most important features of this



Plan of a typical floor (west half)

building is the arrangement by which ten standard refrigerating cars can be run end-on into it and closed by Kinnear rolling steel doors. The floor beneath is here designed for Cooper's E.50 loading and the upper level roadway (just across the interior of the building) designed for a 24 ton auto truck. This arrangement of freight car and upper level way, both ot the same level and running the entire length of the warehouse, make it most convenient. Cars can be filled or emptied without any undue loss of refrigeration; it also provides an excellent means of shifting merchandise, for, whether from wagon or freight car, it may be run along convey rails, hung from the ceiling, directly into any of the four large freight elevators. There is space for an additional four elevators which will be placed when required. Half of these will serve the basement, as well as all the floors. They have a platform 9 ft. by 12 ft., and a normal capacity of 12,000 lbs. when running at a speed of 90 ft. per minute, and are of the overhead traction type, operated by a special high torque 40 h.p. motor. There is also an electric passenger elevator having a normal capacity of 2,000 lbs when travelling at the rate of 200 ft. per minute. The size of the platform is 5 ft. by 6 ft.; all manufactured and erected by Darling Brothers Limited, Montreal.

Fireproof Precautions

Although the nature of the materials used in the construction of the warehouse renders it practically fireproof, automatic fire sprinklers have been installed. In the event of fire four overhead storage tanks, each containing 15,000 Imperial gallons of calcium chloride solution are connected with the sprinkler system. This solution is of a density claimed to have an extinguishing effect of not less than 660 per cent higher than water and if not sufficient can be supplemented by the city water supply which can be automatically turned on the sprinkler system, through the operation of two 8 inch automatic deluge valves. An alarm system has also been installed consisting of devices installed on the ceilings of the various rooms, which operate red signal lights in the corridors and also loud fire gongs, when a sudden change of temperature is applied. These signals which are also transmitted to the offices of the general superintendent, and to the power house, by means of a gong and floor indicator, enable the operators to ascertain the location of a fire and effectively deal with it from the corridor hydrant even before the automatic sprinklers may operate. Other precautions such as automatically closing doors, operating on a sudden change of temperature principle, will close all elevator and stair shafts, thus preventing all draughts. A fire wall dividing the building cross wise is a further step in a most complete fire prevention system.

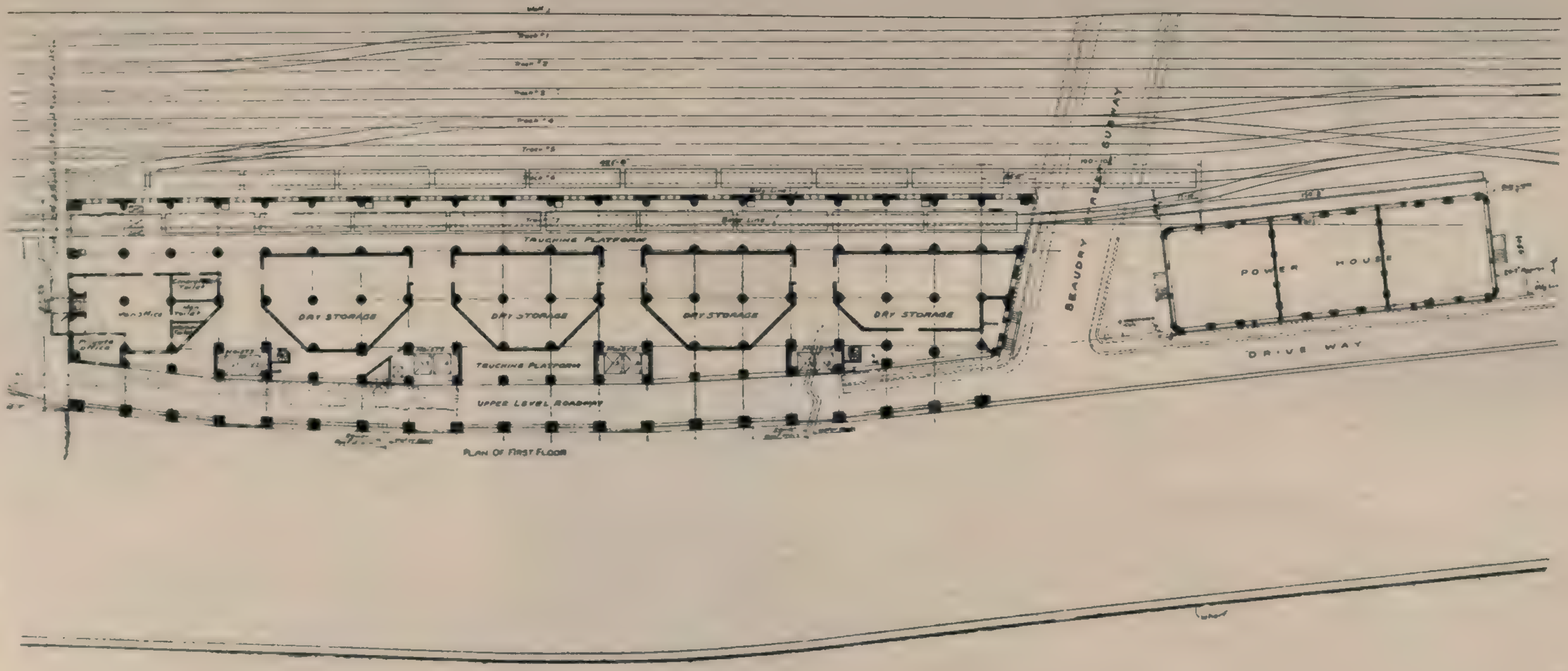
3,000 piles were required for foundation purposes

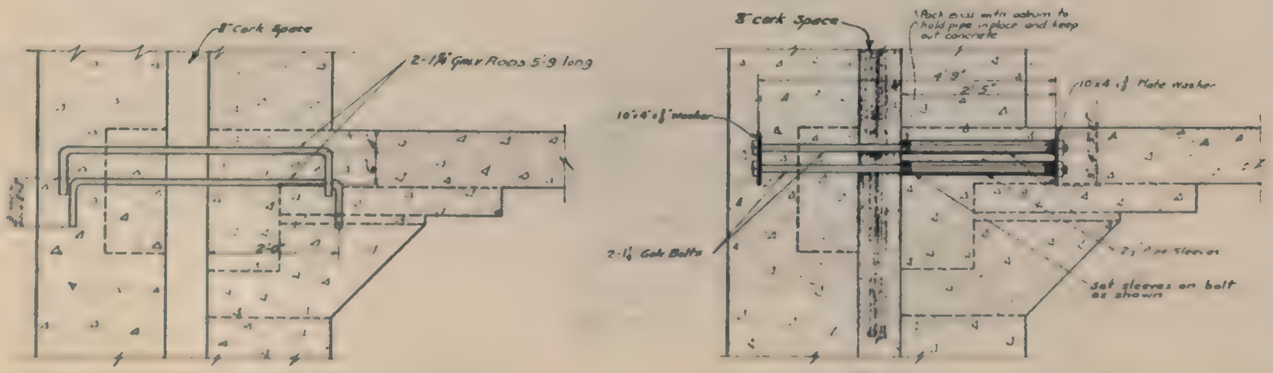
The automatic sprinkler system and the special alarm system were installed by the Automatic Sprinkler Company of Canada, Limited, with the exception of the overhead tanks, which were furnished and erected by the Horton Steel Works, Limited, of Bridgeburg, Ontario.

By the inclusion of the above precautionary measures, the insurance rate is so reduced that the entire cost will be paid for in a few years, besides affording continuous protection to the building and its contents.

Cold Storage Equipment

The cold storage equipment has many features which are well worth describing, one of which is the care taken of the air in the cold storage rooms. The food products stored give off gases, odors, heat and moisture which must be removed for the proper preservation of the





Above: General plan of the Montreal Harbor Commissioners' cold storage warehouse and power house.

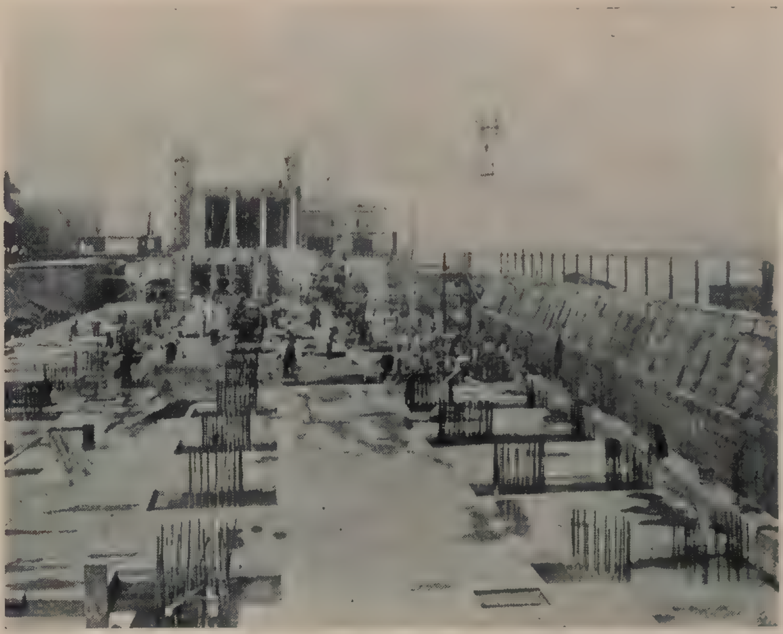
Left: Details of tying-in rods for columns of (1) third and fourth floors; (2) fifth, sixth, seventh and eighth floors.

food. For this reason and also due to the difference in temperature of the various floors each cold storage floor has a conditioning room where the air may be drawn from any cold storage room, thoroughly washed, brought to the proper humidity, purified by the introduction of a proper amount of ozone, and slightly reduced in temperature to prevent condensation as it enters the cold storage room. The introduction of the ozone into the washed air previous to its return, not only purifies the circulating air but also destroys such germs or impurities as may exist in the room into which it enters.

Another important item in the equipment of the warehouse is the completeness of the thermometer installation, relating to the temperature of each of the cold rooms. A floor operator in the corridor may read from an indicating dial the temperature inside a cold storage room without having to enter. There is also a complete system of recording thermometers with continuous charts, situated in the offices of the general superintendent of the warehouse which can be referred to in case of disputes between the owners of the goods stored and the operators of the building, thus insuring confidence and good relations.

The only refrigerant used in this cold storage warehouse is a calcium chloride solution of such a density as to prevent it from congealing under temperatures considerably below the temperature of the various cold rooms. This solution, is pumped by four electrically driven brine circulating pumps delivering, each, 600 Imperial gallons of brine to the warehouse per minute through a 15 inch outside diameter steel pipe. Return is by a similar pipe placed below the other and wrapped together with it with insulating wrappings. These pipes run along the basement of the warehouse and, at different points, four 8-inch branch lines lead at right angles from the basement mains to supply the cooling coils branching off at right at each floor. A method of preventing the coldrooms on the second floor from receiving a greater pressure of brine than those above has been devised by the use of brine risers which are supported at each successive floor level and, instead of being rigidly clamped, rest on spring supports. These adjustments are necessary since serious accidents have occurred in mechanical refrigeration plants due to the fact that insufficient consideration has been given to expansion strains.

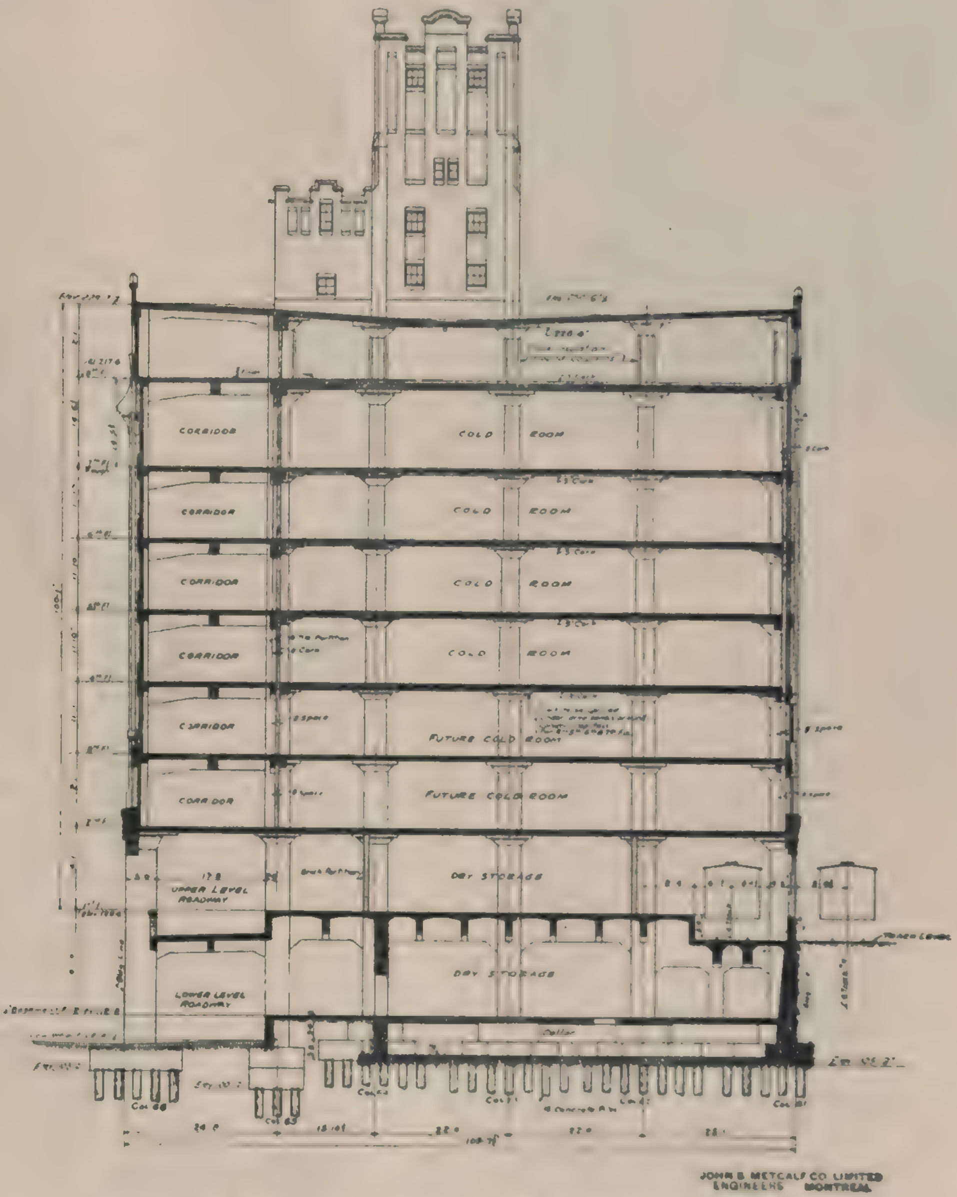
The cooling of the rooms is accomplished by circulating the calcium chloride solution through hundreds of thousands of feet of 2 inch galvanized pipe suspended from the ceilings of the various rooms, the number of linear feet of piping in each room depending on the desired degree of temperature required. These pipes quickly became covered with frost and appear like bars of snow often 6 to 8 inches in diameter. This deposit must be occasionally removed. In case the solution should be cut off from these pipes, and the room allowed to warm up a little, this frost deposit would either be absorbed by the air or drip off into drip pans running along beneath the pipes.



A construction view showing the waterproof foundation slab and the column rods.

Insulation of Storage Rooms

The insulation of the cold rooms, which is very costly but also an important feature of this warehouse, has been limited for the present to four floors with the possible extension at a minimum of cost to additional floors as business warrants. The materials used for this purpose are compressed card-board in layers, which is cemented in against the walls and ceiling in thicknesses ranging from 4 to 7 inches according to the position of the rooms and temperatures to be maintained. The whole is painted over in white and has a very neat appearance. This contract was carried out by two firms: the Armstrong Cork and Insulation Company, of Montreal and the Canadian Cardboard Co., of Port Colborne, Ontario. Similarly the brine mains were covered with four inches of compressed cord (this further contract being carried out by the Armstrong Company) since some of the cold rooms must be maintained at as low a temperature as 5 degree F. below.



Typical cross section of the Montreal Harbor Commissioners' cold storage plant

Summing up, it can be said that in this new warehouse, which encloses a space of about 4½ million cubic feet, there are about 1½ million feet in the form of cold rooms, about two million feet in the form of dry storage and a million cubic feet in the form of corridors, roadways and cellars.

The Power House

The power house, which is approximately 150 by 50 feet, consists of a basement, two upper storeys and a condenser house. Though over-shadowed by its big neighbor, its outside appearance is quite pleasing and in keeping with the general lines of the warehouse. Two thirds of the interior space is used to accommodate the mechanical refrigerating equipment for the cold storage warehouse, and the remainder is used for the rotary and static electric transformers and the switch boards for the Harbor Electric Railway, which will soon be in active operation along the nine mile freight yard bordering the river and connecting with the C.N.R. and C.P.R. at McGill Street and Hochelaga.

In order to obtain a flow of very cold water for the ammonia condensers and for general cooling purposes, it was decided to sink an artesian well east of the Beaudry Street tunnel.

An interior view to show the flat slab construction

A 10-in. well was sunk to a depth of approximately 1100 ft. by means of a 10-in. Church bit together with drilling tools weighing 2100 lbs., and supported to a walking beam by means of ⅞-in. steel wire, there being a swivel joint between the wire and the walking beam by which the tool is rotated and lowered slightly between blows. A steam cylinder operated the walking beam which alternately lifted and droped the bit. This contract was given to Messrs. Wallace Bell & Co., well drillers, and the work of excavation extended over a period of five months.

There are at present installed three ammonia compressors and the piping is distributed in such a way that any one of the three machines may supply the entire system.

The three horizontal belt-driven Linde Ammonia Compressors each have a normal refrigerating capacity of 150 tons which can if necessary be increased to 200 tons per day. Spent gas is circulated from the brine coolers' expansion coils, pumped to the atmospheric condensers located in a cupola on the roof of the power house, and then back to the ammonia compressors through the necessary valves and fittings.

An air lift pump connected with the artesian well supplies a continuous flow of water at about 49 degrees F. to large reservoirs situated above the condensers. These reservoirs each have a capacity of 21,500 gallons and deliver water at the rate of 300 gallons per minute over the condenser coils.

The liquid ammonia flows into steel receivers, which supply the expansion coils immersed in the brine coolers, thus lowering the temperature of the brine before its circulation through the warehouse.

On the same floor is also situated a small ice making tank which is capable of making 5 tons of ice per day in 100 lb. blocks.

On the first floor above the compressor room are located two large brine coolers, each tank being about 36 feet long by 26 feet wide by 8 feet deep and weighing 60 tons. These are supported entirely at the four corners on columns of the building.

The brine coolers contain approximately 210 tons of solution which can be used as a reservoir for cooling the rooms for several hours should it be necessary to stop the compressers. Four electrically-driven brine circulating pumps deliver, each, 600 Imperial gallons of brine to the warehouse per minute; this is recorded by a Venturi meter. In addition, there is installed a recording and indicating equipment recording the temperatures of the solution when leaving for and returning from the cold rooms, the difference in temperature being only 3 degrees—a tribute to the efficient design of the plant.

All pipe used to convey ammonia is extra-strong steel, special ammonia pipe rolled by Canadian mills. The valves and fittings used to distribute and control the ammonia in the power house are all crane flanged ferro-steel, tongue and groove. Due to the necessity of making all piping perfect, so as to prevent any ammonia leaks, fittings, valves and pipe joints were subjected to a 300 lb. air pressure immersed in water before being erected.

Many firms have already contracted to make use of the Harbor Commissioners cold storage plant. Added prosperity for the Port of Montreal which now holds seventh place as a shipping center, is further assured in consequence of the possession of this modern refrigeration plant. If it does not prove as popular as the grain elevators it will not be the fault of the Montreal Harbor Commissioners.

Contractors and Supplies of Material on Montreal Harbor Storage Building:

Canadian McArthur Concrete Pile Co., concrete pile.
Canada Cement Co., Ltd., cement.
Consolidated Sand & Gravel Co., Ltd., sand.
St. Laurent Quarry Ltd., stone.
R. H. Miner Co., stone.
Steel Co. of Canada, Ltd., reinforcing steel.
Interprovincial Brick Co., face brick.
Montreal Terra-Cotta Co., Ltd., tile.
Castona Products Ltd., artificial stone.
Vulcan Steel & Iron Works, steel stairs.
Geo. W. Reed & Co., Ltd., roofing and metal doors.
Metal Shingle & Siding Co., Ltd., rolling steel doors and steel sash.
Douglas Bros. Ltd., kalamein doors.
H. H. Symmes & Co., mastic floors.
Jas. Robertson & Co., Ltd., Thos. Robertson & Co., Ltd., Dennis Wire & Ironworks Co., Ltd., plumbing, fixtures and fittings.
Darling Bros., Ltd., elevators.
Dodge Mfg. Co., of Canada, carpuller machinery.

Extensive Sewer Overflow System for the City of Hamilton, Ont.

A Comprehensive Review of the Design, Construction Methods and Costs of a Large Project Involving 10,000 Feet of Brick and Concrete Sewers in Open Cut and Tunnel

By W. M. JOHNSTON
Engineer of Sewers and Underground Construction, Hamilton, Ont.

For some years past the city of Hamilton, Ont., has been confronted with the problem of taking care of storm water, particularly in the downtown or business district where the floodings were occurring during almost every rain storm, due principally to the rapid growth in area and population, the industrial development and the large paving programme being carried on, there being nearly seventy miles or over one and a quarter million square yards of pavement in the city at present. A glimpse at table No. 1 will show the rapid increase in area population from the year 1813 when George Hamilton, founder of the city, made his first survey, a hamlet of 150 people, to the present time when there is a population of 120,235.

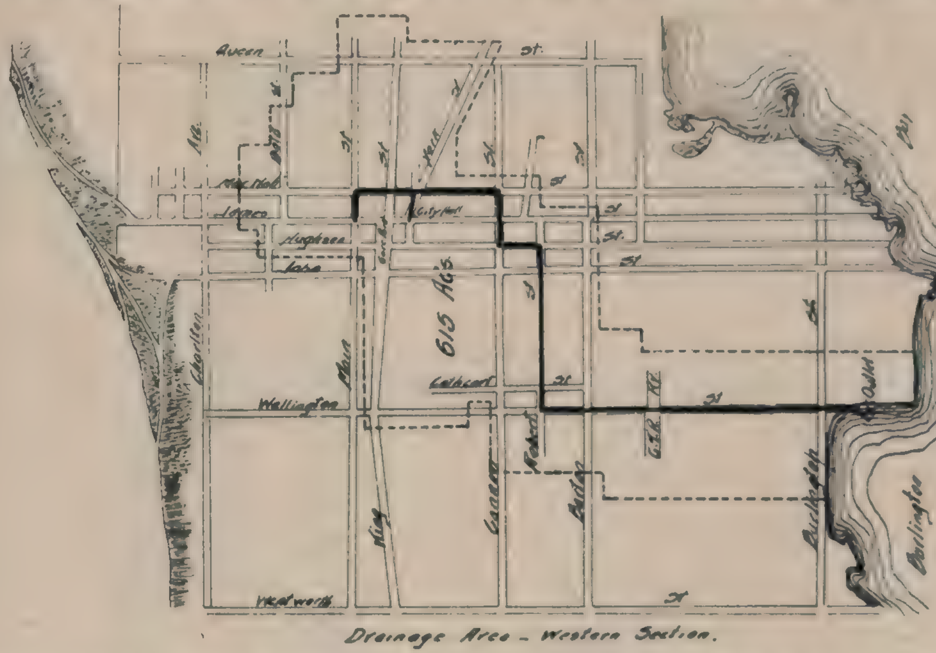


Fig. 1—Map of a portion of Hamilton, showing the drainage area and the location of the storm overflow

It was not until the year 1920 that any definite move was made to relieve the flooding situation. In that year a money by-law for $850,000 for the construction of a storm sewer for the western section of the city was presented to and passed by the ratepayers, this by-law giving the council the authority to issue debentures and raise the money required for the system. Work was then begun on the design of a system for the carrying off of storm

Table No.1.—Area and Population of Hamilton

Year.	Area.	Population.	Year.	Area.	Population.
1813		150	1910	6,090 acres	73,538
1830		1,200	1911	6,260 "	82,095
1870		25,947	1912	6,260 "	88,922
1875		31,708	1913	6,260 "	100,808
1880		35,359	1914	6,450 "	101,314
1885		41,280	1915	7,143 "	100,461
1890		45,423	1916	7,143 "	104,491
1895		48,803	1917	7,143 "	107,832
1900	3,990 acres	52,665	1918	7,143 "	108,000
1902	4,077 "	54,035	1919	7,143 "	108,143
1903	4,602 "	54,761	1920	7,143 "	114,766
1904	6,000 "	57,561	1921	7,684 "	118,243
1908	6,030 "	70,000	1922	7,684 "	120,235

water in the section of the city shown on the accompanying plan (Fig. 1) with an area of 615 acres. The route of the sewer is shown by the full line. In order to serve this district an outlet with a carrying capacity of eleven hundred cubic feet per second was found necessary.

The system was divided into five contracts: Contract No. 1 on Wellington St. from the Bay to 1600 feet southerly; contract No. 2 from station 16 + 00 to station 33 + 30 (Barton St.); contract No. 3 on Wellington St. from Barton St. to Robert St. and on Robert St. from Wellington St. to John St., a distance of 2715 feet and crossing under twenty two tracks of the Grand Trunk Railway Co.; contract No. 4 on John St. from Barton St. to Robert St. and thence to MacNab St. and King St. via Robert, Hughson, Cannon and MacNab Streets, a distance of 3827 feet; contract No. 5, York St. from MacNab to James Street, McNab St. from King to Main Street and Main St. from MacNab and James Street.

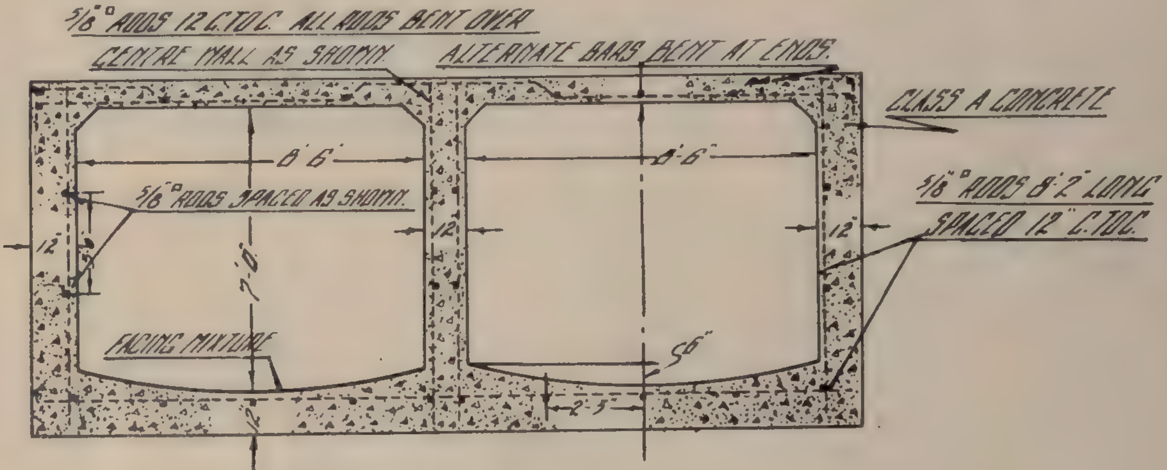


Fig. 2—Rectangular turn section used in the first 118 ft. of the sewer

On these contracts the unit system of tendering was adopted, with a view to relieving the contractor of certain hazards and at the same time allowing the city to reap the benefit of certain methods or special types of construction which may prove unnecessary after the ground has been opened up.

Contract No. 1

This contract was awarded to A. Cope and Son, Hamilton, at a contract price of $181,198.00. Work was commenced at the Bay on November 15, 1921. The excavation was carried on by means of a steam shovel and drag line, the steam shovel taking out the top lift to a depth of about eight feet and the drag line the balance. The excavation was brown clay on top, and blue clay and water underlying with occasional seams of running sand. The depth varied from eight to twenty-one feet.

Owing to the nature of the ground at certain points, steam and electric railways crossing the street and the profile of the surface of the ground along which the sewer ran, it was found necessary to build six different sections. The first one, from the Bay 113 feet southerly, was a 7'-0" x 8'-6" rectangular twin (see Fig. 2) with 2.05 cubic yards of 1-2-4 concrete and 145.5 pounds of steel reinforcing bars per lineal foot. The second section was of the same internal dimensions, but as it crossed under the Burlington St. railway tracks, and there being very little covering over the roof slab, the section was made heavier and 12" x 31½ pound I-beams spaced at four feet centres were used. In this section there were 2.3 cubic yards of 1-2-4 concrete, 167 pounds of reinforcing bars, and 156 pounds of steel I-beams per lineal foot of sewer.

The third section was of the horseshoe type (Fig. 3), 12'-10" x 10'-3" and 1070 feet in length and containing 2.23 cubic yards of 1-2-4 concrete and 416 pounds of square steel reinforcing bars per lineal foot of sewer.

At this point, a sag in the road necessitated a flatter section, and the one adopted was a 5'-11" x 8'-0" rectangular twin, containing 2.08 cubic yards of 1-2-4 concrete and 245 pounds of square steel reinforcing bars per lineal foot of sewer.

The fifth section was of the same internal dimensions as the above, but being under a spur line of the Grand Trunk Railway Co. was made considerably heavier to meet the approval of the Grand Trunk engineers. This section contained 3.59 cubic yards of 1-2-4 concrete and 342 pounds of Steel I-beams per lineal foot of sewer.

It was felt that as the city held senior rights at this crossing, as well as other crossings along the line of the sewer, the railway company should bear the excess cost of construction necessitated by such crossing and an appeal was made to the Dominion Railway Board for a ruling, which body, after some months deliberation, ruled in favor of the railway.

The sixth section was similar to the fourth except that owing to the sewer being constructed across a fill, a pile foundation was necessary. The pile bents were driven at four foot centres and compressed five piles to the bent, and varied from ten to twenty-five feet in length. This section contained 2.24 cubic yards of 1-2-4 concrete and 245 pounds of steel reinforcing bars per lineal foot of sewer.

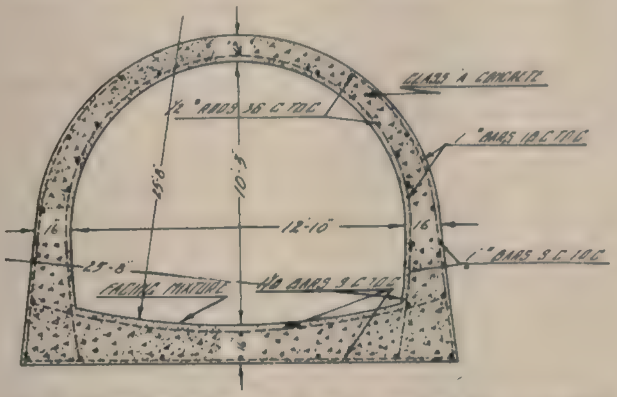


Fig. 3—Horseshoe section used in part of contract No. 1, on which work was done in winter time. Costs are detailed in Table 2.

Considering that this work was done in winter weather, very favorable progress was made. All concrete materials were heated by means of steam from a boiler specially fitted up for that purpose. A steam grill was made with ¾" pipe, drilled with small apertures, about a foot apart, through which the steam escaped; the sand and stone were piled upon this grill. Each section of concrete was carefully covered with tarpaulins, and salamanders placed inside the completed sewer, while steam piles were laid above the concrete under the tarpaulins which protected the newly poured concrete from any danger of frost.

In all this work Blaw collapsible steel forms were used and proved very satisfactory. The invert was poured first and the walls were extended up to six inches at the sides to form a guide for the forms. The invert was kept sixty feet ahead of the walls and crown. The forms on the horseshoe section were telescopic so that the rear section could be telescoped and by means of a travelling car moved forward under the sections, and set in place, the traveller serving as an extra support for the form while the concrete was being poured. The sewer was cast in twenty-four sections, eighty feet of forms being required, as they were not released under three days. Table No. 2 will give some idea as to the cost of this work.

On this contract, it was found necessary to raise the Ferrie St. bridge five feet as the sewer at this point was above the ground and necessitated the raising of the street grade. This bridge was of steel construction with wood deck and rested on concrete piers. It was raised bodily without dismantling, and the piers raised to the new elevation. The bridge was 432 feet in length.

Concrete was mixed in a London mixer on the edge of the trench, and placed by gravity. Backfilling was done principally by means of steam shovel.

Contract No. 2

This contract was also awarded to A. Cope & Son, Hamilton, at a contract price of $174,261.00, and is a continuation of contract No. 1, extending from station 16 + 00 to station 33 + 30 or Barton St. It was also executed in open cut. The first section from a point south of Ferrie St. to Simcoe St. was at one time an inlet, and it was found necessary to construct the sewer, which was a 5'-11" x 8'-0" rectangular twin section, on piles, these varying in length from 8' to 25'. They were driven by means of a steam hammer at four foot centres with five in each bent. This section contained 2.24 cubic yards of 1-2-4 concrete, 208 pounds of square

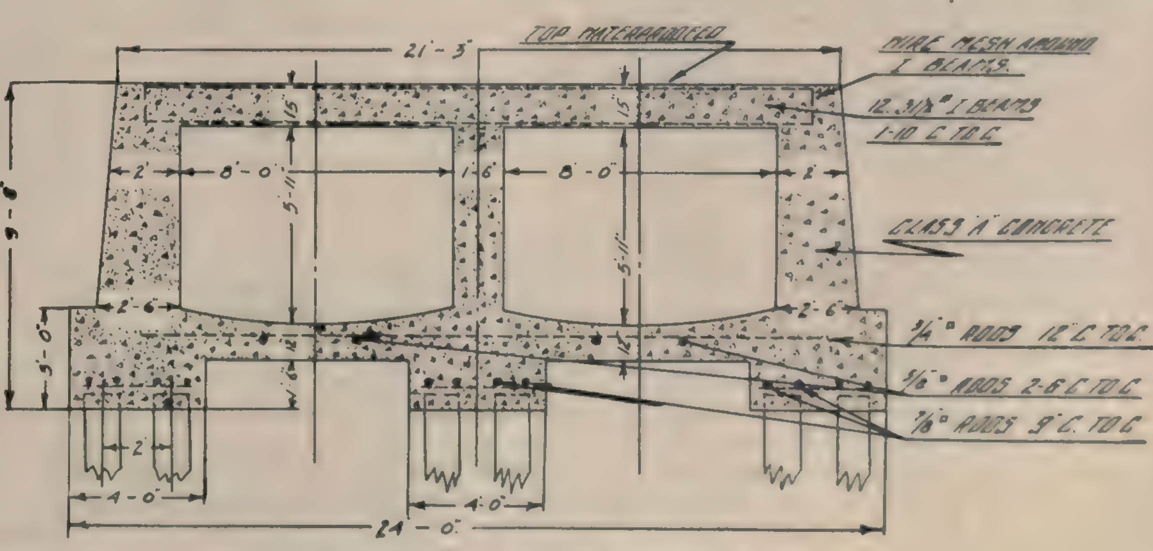


Fig. 4—Heavy section used under railway tracks (contract No. 2)

steel reinforcing bars and 148 pounds of steel I-beams per lineal foot of sewer.

From station 16 + 95 to station 18 + 29 the sewer was of the same internal dimensions as the above, but as it passed under five industrial spurs of the Toronto, Hamilton and Buffalo Railway Company, the section was made somewhat heavier (Fig. 4), and contained 3.59 cubic yards of 1-2-4 concrete and 400 pounds of steel I-beams per lineal foot of sewer. On this section, the contractor entered into negotiations with the railway company, who allowed their tracks to be cut during construction. The depth of the excavation on these sections varied from six to nine feet and was taken out with a steam shovel, the excavation being removed before the piles were driven.

At 18 + 29 the section changed to a horseshoe shape, 9'-3" x 11'-0", containing 2.05 cubic yards of 1-2-4 concrete and 332 pounds of square steel reinforcing bars per lineal foot of sewer. This section was continued to the end of the contract except from station 22 + 82 to station 24 + 14 which passed under the 17th division of the Grand Trunk Railway Company's six tracks, the section at this point being the same internal dimensions with 2.05 cubic yards of 1-2-4 concrete and 572 pounds of square steel reinforcing bars per lineal foot. The average depth of excavation under the tracks was 24 feet.

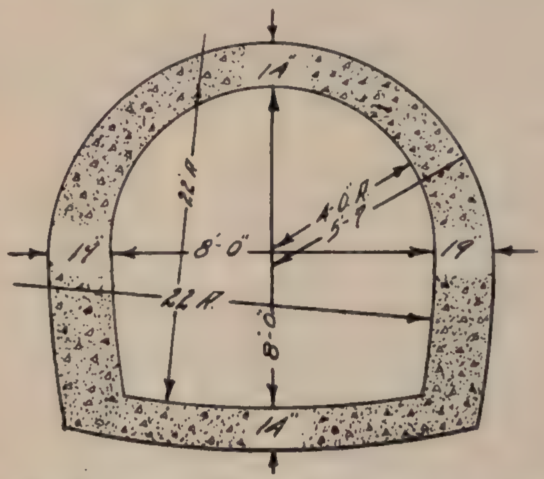


Fig. 5—Heavy horseshoe section adopted under railway tracks in Contract No. 5. The sewer was constructed in tunnel

In order to construct this section of sewer and maintain freight and passenger traffic, the railway company supported their tracks by means of pile bents, one five-pile bent being driven under each track on both sides of the cut, six feet below the subgrade of the sewer. These bents were capped with 12" x 12" caps and three stringers 10" x 20" x 30' placed under each rail which were left in place for two months after the sewer had been completed and backfilled. The excavation for this section was principally hand work, and was hoisted by means of a track crane.

From this point southerly a distance of 350 feet the greatest care was exercised as the side of the cut, the sewer being 24 feet deep, was only eight feet from the west mill of the Steel Company of Canada and their numerous machines, continually pounding and producing an enormous vibration, it was difficult to prevent the soft blue clay encountered in this excavation from squeezing and allowing the foundations of the building to settle. This difficulty was overcome, however, by driving steel sheet piling to a depth of six feet below the subgrade of the sewer and heavily timbering with 10" x 12" walings and 12" x 12 struts, all of which were left in place after the completion of the work.

Owing to the mass of underground construction between this point and Barton St. it was found necessary to relay about 750 lineal feet of 12" water main and 750 lineal feet of 4" gas main. New pipe was used and the old pipe salvaged as the excavation was taken out. On this section also, steel sheet piling was used, but was withdrawn after the sewer and backfill was completed.

The top eight feet of excavation, which was principally sand, was taken out with a steam shovel, the average rate of excavation being 40 cubic yards per hour; the balance, a sticky blue clay, was removed with a drag line excavator and by hand. This was loaded into waggons, teamed back to the completed section of sewer where the loaded waggons were picked up by means of a crane swung over the trench, lowered and dumped.

Blaw collapsible steel forms were also used on this contract. The concrete was mixed in a steam operated London mixer along the side of the trench and placed by gravity. The aggregate used was either 1" broken stone or 1" water-washed screened gravel. The concrete was well spaded and the surface secured with the steel forms required very little finishing except at construction joints. The invert, having a dish of six inches, was trowelled to a smooth finish.

No lack of plant and equipment was evident in the construction of this work, there being a steam shovel, drag line excavator, crane, pile driver, two ¾ cubic yard London concrete mixers, road grader, waggons, trucks and all other construction equipment necessary for the proper completion of the work.

Contract No. 3

This contract was awarded to the J. H. McKnight Construction Company of Toronto, at a contract price of $192,700.00, and was principally a tunnel proposition. The first section on Wellington St. from Barton St. to Robert St. was a horseshoe shape 9'-3" x 11'-0" and 750 feet in length. On this contract, working shafts were sunk before tenders were called for in order to give the contractors a fair idea of the nature of the ground. The first shaft was at station 3 + 75 and was sunk 26' to subgrade, the bottom 8½ feet being solid rock.

Mining was started in both directions from

TABLES II, III, IV

Table No. 2.- 12'-10" x 10'-3" Reinforced Concrete H. S. Section - Contract No. 1.

Acct. No.	Account Name.	Unit.	Total Labour Cost.	Unit Labour Cost.	Total Material Cost.	Unit Material Cost.	Total Cost.	Total Unit Cost.
1-4-01	Engineering & Inspection.		1442.37				1442.37	2%
1-4-02	Excavation.	14,930 c.y.	5917.83	.39	618.04	.04	6535.87	[illegible]
"	Rental Shovels.	"			2250.00		2250.00	.15
1-4-03	Timbering.	1,051 l.f.	1350.58	1.29	107.25	.10	1457.83	1.39
1-4-05	Backfill.	8,230 c.y.	3905.40	.48	140.73	.02	4046.13	.50
"	Rental Shovel.	"			510.00	.06	510.00	.06
1-4-06	Surplus.	6,700 "	753.00	.11			753.00	.11
1-4-07	Forms.	27,654 s.f.	3242.25	.12	247.71	.01	3489.96	.13
"	Rental Crane.				1540.00		1540.00	.05
1-4-08	Reinforcing Steel.	4,648 cwt.	1405.76	.30	11619.87	2.50	13025.63	2.80
1-4-12	Concrete Invert 1-2-4	1,311 c.y.	2027.08	1.55	12045.25	9.18	14072.33	10.73
"	Rental Mixer.				376.00	.29	376.00	.29
1-4-13	Concrete Walls 1-2-4	315 c.y.	781.08	2.48	2945.59	9.35	3726.67	11.83
"	Rental Mixer.				183.00		183.00	.58
1-4-14	Concrete Crown 1-2-4	892 c.y.	1257.80	1.41	9308.07	10.43	10565.87	11.84
"	Rental - Mixer.				187.00		187.00	.21
1-4-18	Finishing Concrete.	13,302 s.f.	308.50	.02	468.15	.04	776.65	.06
1-4-19	Heating Materials.	2,518 c.y.	328.87	.13	76.37	.03	405.24	.16
"	Rental Boiler.	"			643.00		643.00	.25
1-4-22	Manholes.	[illegible] l.f.	6.75	.83	27.30	3.41	34.05	4.24
1-4-30	Sundries.	1,051 l.f.	795.95	.76			795.95	.76
1-4-31	Overhead, etc.	"	2352.32	2.24	4334.33	4.12	6686.65	6.36
	TOTALS.	1,051 l.ft.	25,875.54	24.62	47627.66	45.30	73503.20	69.92

Note: Overhead (1-4-31) Taken as 10% of cost intended to cover sundry items, such as electric bills, telephone, hardware, and other bills not procurable by Resident Engineer.

Table No. 3. 9'-3" x 11'-0" H. S. Section in Rock Tunnel. Contract No. 3.

Acct. No.	Account Name.	Unit.	Total Labour Cost.	Unit Labour Cost.	Total Material Cost.	Unit Material Cost.	Total Cost.	Total Unit Cost.
3-1-01	Engineering & Inspection.		2186.00				2186.00	8.4%
3-1-02	Drilling & Blasting.	1717 c.y.	2168.25	1.27	1454.52	.85	3622.77	2.12
"	Mucking.	1717 "	3534.60	2.06	95.17	.05	3629.77	2.11
"	Rental of Hoist.	1717 "			1087.50	.63	1087.50	.63
"	Rental of Compressor.	1717 "			595.00	.34	595.00	.34
3-1-04	Removing Surplus,	1717 "	2239.37	1.30			2239.37	1.30
3-1-05	Forms.	8867 s.f.	1016.50	.11	715.00	.08	1731.50	.19
3-1-06	Concrete 1:3:5	597 c.y.	2366.40	3.96	4630.16	7.76	6996.56	11.72
"	Rental of Mixer.	597 c.y.			415.00	.69	415.00	.69
"	Finishing Concrete.	8867 s.f.	246.40	.03	65.42	.01	311.82	.04
3-1-07	Erecting Plant.	377 l.f.	1115.92	2.96	821.86	2.18	1937.78	5.14
3-1-08	Repairs to Equipment.	377 "	556.50	1.47	415.41	1.10	971.91	2.57
3-1-09	Sundries.	377 "	1320.00	3.74	1015.00	2.70	2335.00	6.44
	TOTAL:	377 l.f.	16,749.94	44.43	11,310.04	30.00	28059.98	74.43

Note : Thompsonite per cubic yard rock excavation = 2.6 lbs.
Detonators " " " " - 1.0

Table No. 4 - 9'-3" x 11'-0" H. S. Section in Clay Tunnel - Contract No. 3.

Acct. No.	Account Name.	Unit.	Total Labour Cost.	Unit Labour Cost.	Total Material Cost.	Unit Material Cost.	Total Cost.	Total Unit Cost.
3-1a-01	Engineering & Inspection.		852.17				852.17	6.3%
3-1a-02	Mining.	1371 c.y.	1,245.65	.91			1,245.65	.91
"	Rental of Compressor.	"			295.00	.21	295.00	.21
3-1a-03	Mucking and Hoisting.	"	1,867.00	1.36	96.26	.07	1,963.26	1.43
"	Rental of Hoist.	"			265.00	.20	265.00	.20
3-1a-05	Removing Surplus.	"	1,180.42	.86			1,180.42	.86
3-1a-07	Forms.	6892 s.f.	639.40	.09	700.00	.10	1,339.40	.19
3-1a-09	Concrete 1-3-5	464 c.y.	1,606.25	3.46	3,376.41	7.28	4,982.66	10.74
"	Rental Mixer.	"			310.00	.67	310.00	.67
"	Finishing Concrete.	6892 s.f.	125.50	.02	30.31	.005	155.81	.025
3-1a-10	Repairs to Plant.	293 l.f.	281.00	.96	180.41	.62	461.41	1.58
3-1a-12	Sundries.	293 "	752.00	2.56	530.00	1.81	1,282.00	4.37
3-1a-13	Erecting Plant.	293 "	867.28	2.96	638.74	2.18	1,505.92	5.14
	TOTAL.	293 l.f.	9 416.67	32.14	6,422.13	21.92	15,838.80	54.06

Cost data relating to contracts Nos. 1 and 3. Further cost data is recorded on page 1249 this shaft, the northerly heading developing into a hard clay excavation fifty feet north of the shaft whereas the southerly heading developed into a solid rock face. Good progress was made at this shaft, an average of six lineal feet per day being made in the clay heading and three feet per day in the rock heading. The clay excavation was taken out by means of pneumatic spades, three spade operators, four muckers, and one truck man handling the underground work, whereas in the rock heading, two drillers, four muckers and one truck man formed the underground organization. Drilling was started near the bottom of the face, the holes pointing diagonally downward and being three feet in length. These were first charged and fired. A second row was then drilled higher up on the face and more nearly horizontal. These were again charged and fired and similarly the third and fourth were discharged.

It was found advantageous to use Thompsonite as an explosive in this work owing to the non-poisonous fumes given off by it, which permitted the men to resume their work immediately after the charge had been fired. The neat excavation in this section was 4.68 cubic yards per lineal foot of sewer, the overbreak in the rock heading was found to run about 0.2 cubic yards per foot or 4.3%.

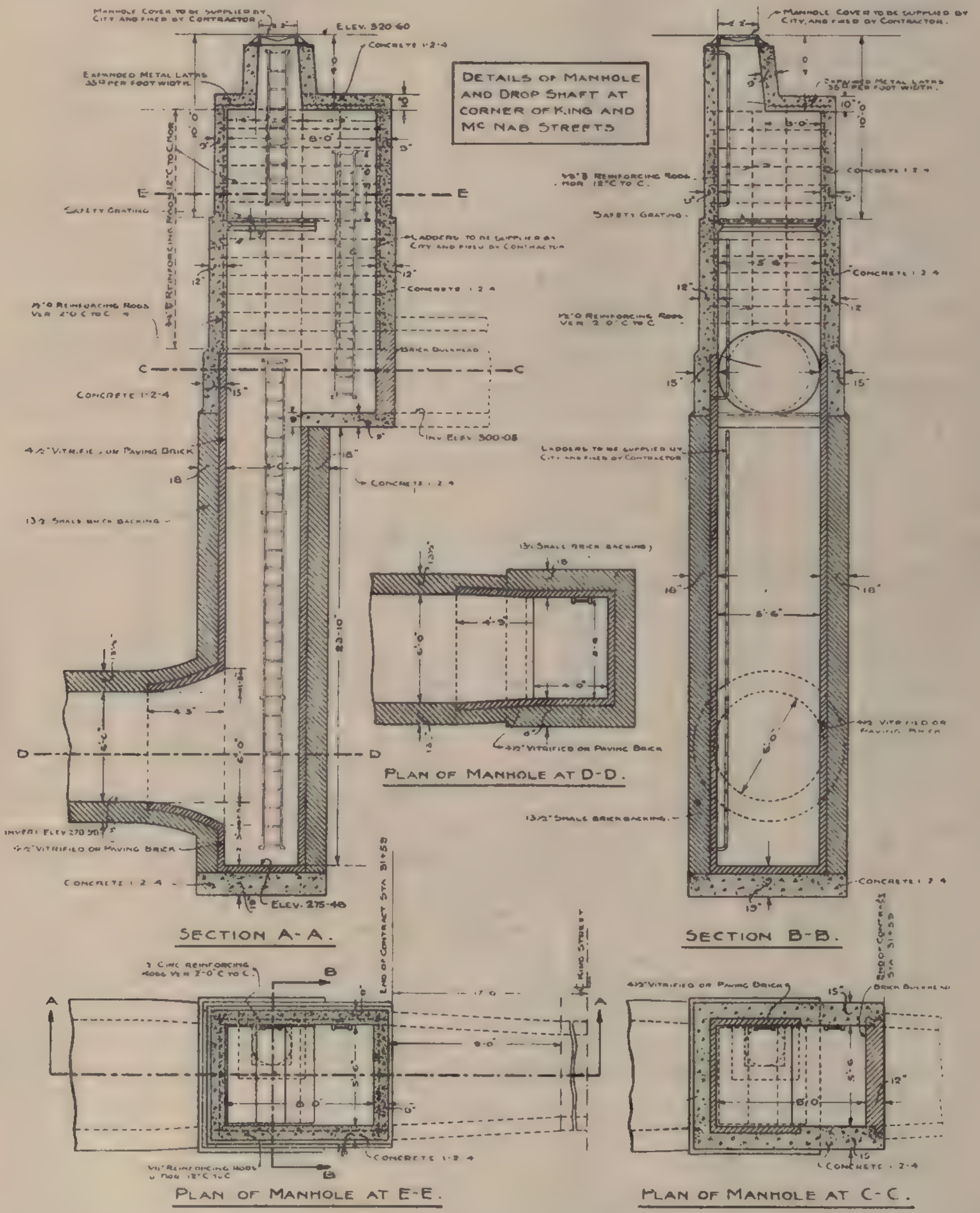

Details of Manhole and Drop Shaft at Corner of King and Mc Nab Streets
Manhole Cover to be supplied by City and fixed by Contractor
Elev. 320·60
Concrete 1·2·4
Expanded Metal Lath 35# per foot width
Safety Grating
Ladders to be supplied by City and fixed by Contractor
Reinforcing Rods Ver 2'-0" C to C
Brick Bulkhead
Inv Elev 300·08
4½" Vitrified or Paving Brick
13½" Small Brick Backing
Invert Elev 270·90
Elev. 275·48
E
C
D
12"
15"
18"
8'-0"
5'-6"
6'-0"
23'-10"
Section A-A.
Section B-B.
Plan of Manhole at D-D.
End of Contract Sta 31+55
King Street
A
B
Plan of Manhole at E-E.
Plan of Manhole at C-C.

Fig. 6—Details of a manhole in connection with the storm overflow sewer, western section, Hamilton, Ont.

The plant required to handle this part of the work was first a head frame with an elevator for hoisting the excavated material. The surplus was loaded into side dump cars in the headings, run on to the elevator at the bottom of the shaft, and hoisted to a runway twenty feet above the street level and run along a trestle and dumped into storage bins of ten tons capacity (two compartments, five tons each). The bottoms of these bins were built with an inclination of 45°, and with a gate at the bottom. This surplus material was hauled away in five-ton motor trucks which were gravity loaded from the storage bins. The elevator was operated by a 32 h.p. steam operated hoisting engine. The spades and drills were operated by compressed air developed by a 10" x 12" Ingersoll-Rand air compressor, driven by a 60 h.p. Westinghouse motor, the compressor worked at a pressure of 112 pounds. In addition to this plant was a machine shop with forge, band saw, circular saw, hack saw, drill and emery wheel, all driven by a 5 h.p. Westinghouse motor, where any small repairs were made.

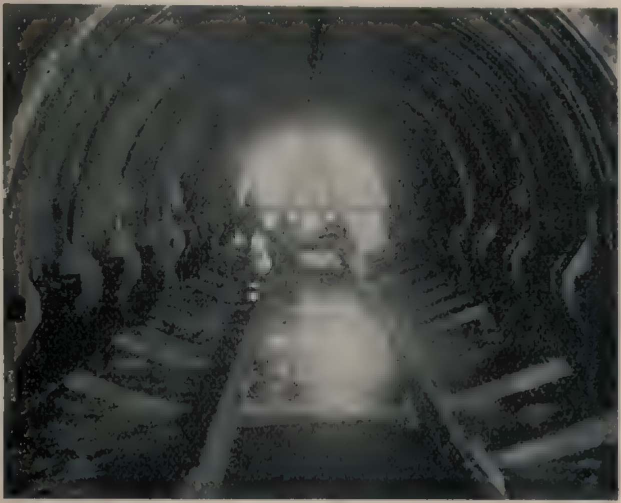


Fig. 7—Blaw collapsible steel forms in open cut

The concrete, which was a 1-3-5 mix, was poured at night at the rate of 9 feet per shift. Only the walls and crown were poured in the first operation, the invert being left out until the headings were completed. Collapsible Blaw steel forms were used, the ribs being set up at three foot centres and the steel plates being placed up to the springing line. The concrete, which was run up on a platform at this elevation was then shovelled in and thoroughly spaded. The remaining forms were placed plate by plate and the concrete brought up at the same time, until the key was reached. These were put in in three foot lengths, the concrete being shovelled in from the front and rammed into place. A ¾ cubic yard Koehring mixer was set beside the shaft and below the ground surface, so that there was no hoisting of materials in charging the mixer. After mixing, the charge was dumped into cars at the bottom of the shaft. The invert was poured last, the bottom being first cleaned out and tracks relaid and the concrete placed and trowelled to a smooth finish at the rate of 90 lineal feet per day.

The concrete organization consisted of one foreman and ten laborers. One finisher, working during the day, kept the walls and crown finished close behind the forms. The tunnels and surface work were all electrically lighted. Tables 3 and 4 indicate the cost of the work at this shaft.

The next section along Robert street from Wellington to Cathcart streets was the same size, and practically the same section except that the concrete was brought up square on the haunches, the work being done in open cut with not more than six feet of covering over the top of the crown. The excavation ran 60% rock. The top lift was taken out with a clam shell excavator, while the rock was drilled with air drills, blasted and removed with the clam shell. Wood forms were used on this section and the concrete was mixed in a gasoline Koehring mixer placed on the side of the trench and deposited by gravity. One-inch water-washed screened gravel was used entirely on this contract. On this section, the invert was poured first and the walls and crown on the second operation. Table No. 5 will indicate the cost of this work in open cut.

At this point a junction chamber was built, the storm sewer reducing in size to an 8'-0" x 8'-0" horseshoe shape, and also picking up the storm flow from the Cathcart sewer, which was about ten feet higher in elevation, the sanitary flow being carried over the storm sewer by means of an 18" cast iron pipe.

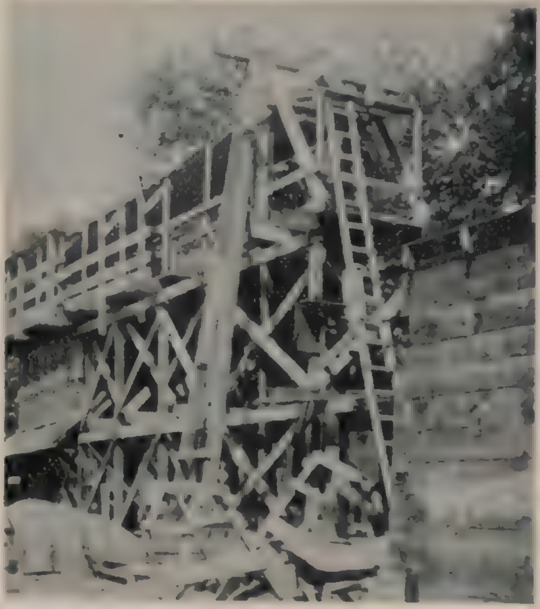


Fig. 8—Headframe on Wellington St., (Contract No. 3)

Westerly from this chamber the sewer was continued through an alley, allowing only two feet clearance between the sides of the trench and the dwellings abutting on it. Care was taken in timbering the trench and no signs of settlement or cracks in the brickwork, developed. The excavation was taken out with the clam and concrete poured as in the previous section.

The next shaft was sunk at Elgin St. and headings run in both directions. Mining was carried on under the same method as shaft No. 1 except that in these headings, the excavation was in good blue clay, and an average of nine lineal feet per day was accomplished in each heading. The sewer at this point was an 8'-0" x 8'-0" horseshoe. The easterly heading was tunnelled under twenty two tracks of the Grand Trunk Railway Co., stringers being placed under one track only. This was a very heavy section (Fig. No. 5) approved by the railway engineer. This part of the work is still under construction and should be completed in January.

Contract No. 4

This contract was let to the Jno. Maguire Contracting Co., Ltd., of Toronto, at a contract price of $187,460.00. This was wholly a tunnel job, 3827 feet in length, 668 feet being a two ring 4'-6" circular brick sewer and 3159 feet being a three ring 6'-0" circular brick sewer. 1800 feet of this was constructed under compressed air.

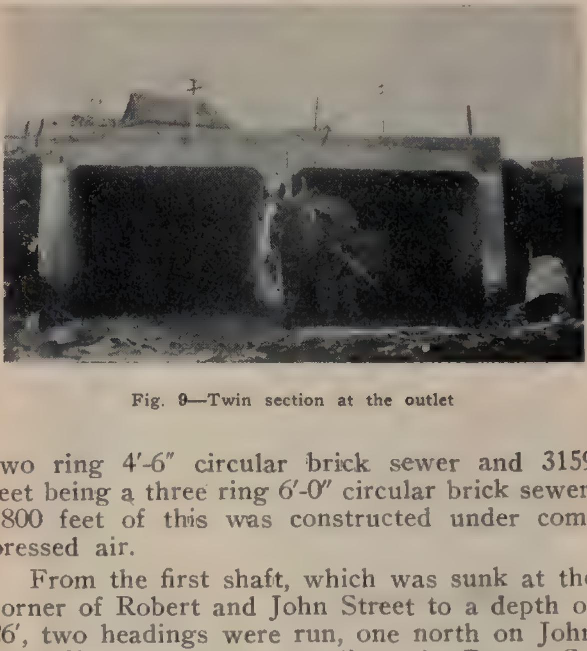


Fig. 9—Twin section at the outlet

From the first shaft, which was sunk at the corner of Robert and John Street to a depth of 26', two headings were run, one north on John St. 668' to intercept and relieve the Barton St. sewer. This was the 4'-6" section and was mined at the rate of 12 lineal feet or 14 cubic yards of excavation per day by two pneumatic spade operators and two muckers who formed the underground organization. From this same shaft a tunnel was mined west on Robert Street and south on Hughson Street, a distance of 610 lineal feet, the excavation being taken out at the rate of 8 feet or 12 cubic yards per day, by two pneumatic spade operators and two muckers underground. The surface organization taking care of both headings consisted of one foreman, one signalman, one hoisting engineer, handy man, dump man and two teams. The excavation in both headings was of a good blue clay nature.

The brickwork in these two headings was placed at night by one bricklayer and two helpers in each heading, and three laborers and a hoisting engineer on top. Four hundred brick per lineal foot were required in the six-foot section and two hundred in the 4'-6" section. The time required to complete the brickwork each night was from seven to eight hours.

The plant required to operate the work at this shaft consisted of one hoisting engine and stiff leg derrick with a bin for surplus earth, (the bin being used only when teams were led up and the standing waggon at the shaft was loaded). The pneumatic spades in each heading were operated by compressed air developed by a 12" x 10" Chicago Pneumatic air compressor, driven by a 60 h.p. Westinghouse motor and capable of delivering 300 cubic feet of air per minute at a pressure of from 100 to 110 pounds.

The second shaft was sunk at the corner of James St. and Cannon St. to a depth of 40 feet, the top 17 feet being good brown clay at which depth wet running sand was encountered which extended to 30 feet to blue clay. The section of the shaft from 15' to 35' was timbered with 2" tongue and groove sheeting which was driven down by an air hammer as the excavation was taken out.

Headings were started in both directions from this shaft and air chambers constructed in each end, and preparations made so that air could be turned on at a minute's notice if found necessary. After mining 120 feet, the westerly heading became shaky and wet, and owing to the enormous weight of water overlying the tunnel and the possibility of sand pockets, it was decided to turn on air. The easterly heading remained good and was continued without the use of air to meet the westerly heading from shaft No. 1 a distance of 640 feet. These two headings started from shafts 1250 feet apart, passed around two right angle curves and came together less than three quarters of an inch off line and an eighth of an inch off grade, for which the credit is due to Mr. F. B. Goedike, resident engineer, in charge of the contract.

In each of these headings, an average of nine lineal feet of excavation and brickwork were completed per day. In the easterly heading three crown planks were used to steady the clay roof, but as this was good hard clay and from five to six feet between the roof and the running sand above, there was little danger of caving. In the air heading, from five to ten planks were used in the crown which were supported by crutches let in at the springing line. From ten to fifteen pounds air pressure was used and very satisfactory work accomplished without accidents. The lumber used in supporting the roof was all left in place and bricked in solid.

Grout pipes were left in the crown of the

TABLES V, VI, VII

Table No. 5. 9'-3" x 11'-0" H. S. Section in Open Cut - Contract No. 3.

Acct. No.	Account Name.	Unit	Total Labour Cost.	Unit Labour Cost.	Total Material Cost.	Unit Material Cost.	Total Cost.	Total Unit Cost.
3-2-01	Engineering & Inspection.		1,031.91				1,031.91	8.6%
3-2-02	Rock Excavation.	1534 c.y.	2,070.60	1.35	339.88	.22	2,410.48	1.57
"	Rental Compressor.	1534 "			215.00	.14	215.00	.14
"	" Clam.	1534 "			444.00	.29	444.00	.29
3-2-03	Earth Excavation.	990 "	553.15	.56	9.35	.01	562.50	.57
"	Rental Clam.	990 "			296.00	.29	296.00	.29
3-2-04	Removing Surplus.	1076 "	1,964.31	1.82			1,964.31	1.82
3-2-05	Backfill.	1500 "	553.00	.37			553.00	.37
3-2-06	Timbering.	230 l.f.	61.30	.26	433.25	1.88	494.55	2.14
3-2-08	Forms.	5386 s.f.	421.40	.076	90.00	.014	511.40	.09
3-2-09	Concrete 1:3:5	416 c.yds.	769.75	1.85	2,832.92	6.81	3,602.67	8.66
"	Rental Mixer.	416 "			178.00	.43	178.00	.43
3-2-10	Finishing Concrete.	5386 s.f.	108.00	.02	28.03	.005	136.03	.025
3-2-11	Plant Erection & Repairs.	230 l.f.	362.25	1.58	147.50	.64	509.75	2.22
3-2-12	Sundries.	230 "	632.00	2.75	401.00	1.74	1,033.00	4.49
	TOTAL.	230 "	8,527.67	37.07	5,414.93	23.54	13,942.60	60.61

Note: Thompsonite per cubic yard of excavation = .65 lbs.
Detonators. " " " " " = .15

Table No. 6. 4'-6" Circular Brick Sewer (Two Ring) in Tunnel. Contract No. 4.

Acct. No.	Account Name.	Unit.	Total Labour Cost.	Unit Labour Cost.	Total Material Cost.	Unit Material Cost.	Total Cost.	Total Unit Cost.
4-7-01	Engineering & Inspection.		567.87				567.87	5%
4-7-02	Mining.	689 c.y.	630.30	.92			630.30	.92
"	Rental Compressor.	"			350.00	.51	350.00	.51
4-7-03	Mucking & Hoisting.	"	769.87	1.11			769.87	1.11
"	Rental of Hoist.	"			140.00	.20	140.00	.20
4-7-04	Timbering.	658 l.ft.			200.45	.30	200.45	.30
4-7-05	Removing Surplus.	689 c.y.	739.00	1.07			739.00	1.07
4-7-06	Brickwork.	118.4 m.	1,505.03	12.71	4,097.00	34.60	5,602.03	47.31
		301 c.y.		5.00		13.61		18.61
4-7-08	Setting up Plant.	658 ft.	126.28	.20			126.28	.20
4-7-10	Foreman & Watchman.	658 ft.	348.52	.53			348.52	.53
4-7-14	Sundries.	658 ft.	657.91	1.00	679.86	1.03	1337.77	2.03
4-7-15	Overhead etc.-10%		534.48		546.73		1,081.21	
	Totals.	658 ft.	5,879.26	8.93	6,014.04	9.14	11,893.30	18.07

Table No. 7. 6'-0" Three ring Circular Brick Sewer - Contract No. 4.

Acct. No.	Account Name.	Unit	Total Labour Cost.	Unit Labour Cost.	Total Material Cost.	Unit Material Cost.	Total Cost.	Total Unit Cost.
4-8-01	Engineering & Inspection.		1212.61				1212.61	3%
4-8-02	Mining.	3080 c.y.	2198.50	.71			2198.50	.71
"	Rental Compressor.	"			1351.00	.44	1351.00	.44
4-8-03	Mucking & Hoisting.	"	3172.67	1.03			3172.67	1.03
"	Rental Hoist.	"			622.75	.20	622.75	.20
4-8-04	Timbering.	1588 l.f.			487.75	.31	487.75	.31
4-8-05	Removing Surplus.	3080 c.y.	2359.75	.77			2359.75	.77
4-8-06	Brickwork.	1418 c.y.		4.43		15.23		19.66
		589.4 m.	6281.74	10.66	21598.29	36.64	27880.03	47.30
"	Rental Hoist.	1418 c.y.				.44		.44
		589.4 m.			622.75	1.06	622.75	1.06
4-8-07	Pumping.	1588 l.ft.	318.14	.20	30.40	.02	348.54	.22
4-8-08	Erecting Plant.	1588 "	345.93	.22			345.93	.22
4-8-10	Foreman & Watchman.	1588 "	1063.79	.67			1063.79	.67
4-8-12	Grouting under pressure.	100 "	52.80	.53	89.15		141.95	1.42
4-8-17	Installing Air Locks & Plant.		409.50		94.94		504.44	
4-8-18	Sundries.	1588 l.ft.	1478.60	.93	239.85	.15	1718.45	1.08
4-8-20	Overheads, etc. 10%		2283.95	1.44	2119.14	1.33	4403.09	2.77
	Totals.	1588 l.ft.	21177.98	13.34	27256.02	17.16	48434.00	30.50

Note: Air locks were installed in case they were required, but above costs represent the work where air was not used. Excavation - good blue clay.

Cost data relating to contracts Nos. 3 and 4 sewer at ten foot centres for fifty feet each side of all manholes and neat cement grout was forced in behind the brickwork under a pressure of 100 pounds. This was done to prevent the water finding its way down the outside of the manholes, and following along the sewer, to cause leaks.

The plant required at this shaft in addition to that used at the former was a 20″ x 12″ low pressure Chicago Pneumatic air compressor operated by a 75 h.p. Westinghouse motor and capable of delivering 1000 cubic feet of air per minute at a pressure of 30 pounds. A steam pulsometer pump was installed in the shaft to take care of the water running out of the sand and flowing down the shaft. This pump worked steadily day and night and pumped at the rate of from 100 to 125 gallons per minute.

A large manhole chamber and drop shaft was designed for the centre of the intersection of James St. and Cannon St. to divert the storm water from the James St. sewer and turn it into the storm sewer. As this manhole was 45 feet deep and at a very busy intersection, directly under the double track of the James St. car line, it was decided to excavate from the bottom and build the manhole as the excavation was taken out. This was done under compressed air and short shifts were taken out and the brickwork followed up. This was carried on to within fifteen feet of the surface and finished from the top, thus avoiding any serious interference with traffic.

The third shaft was sunk at the corner of MacNab St. and Merrick St. to a depth of 40 feet, the nature of the ground being very much the same as at the former shaft except that the flow of water was much greater. In this shaft concrete walls were built inside the timber and extended to the sheeting, all timbers and sheeting being left in place. The wall was built to a height of two feet above the top of the running sand, which prevented the large flow of water from entering the shaft. From this shaft headings were run north to meet the westerly heading from No. 2 shaft and south to King St., the end of the contract. These headings were approximately 600 feet in length, the brickwork being the same as in the former shaft and all work at this point was done under compressed air. This part of the contract is still under construction, and should be completed late in January.

Contract No. 5 has not yet been let, as it controlled a very heavy storm flow and was useless until the remainder was completed. It was therefore deemed advisable to hold it up.

Modern Tendencies in Sewer Design

Must be Considered in Conjunction with the Method of Sewage Disposal—Separate System of Sewers has Limitations Which May Lead to Some Modification—No Outstanding Developments in Construction

By A. G. DALZELL

The design of a sewer system in the present day must be considered more carefully than before in conjunction with the method of sewage disposal. The increasing regard for public health and the realization of the necessity of preserving the purity of water supplies has impelled government authorities to take cognizance of the question of sewage disposal, and municipal authorities have now to consult with provincial or Dominion authorities before they are permitted to discharge sewage into streams, rivers or lakes.

Immense as are the bodies of water comprised in the Great Lakes that are the joint possession of Canada and the United States, the pollution of these waters has become a matter of international concern and co-operative action. In consequence, even municipalities situated on the shores of the lakes are no longer permitted to discharge sewage in any promiscuous way into lake waters and the pollution of streams and rivers is likewise prescribed.

The sewage of Canadian and American municipalities differs greatly from that of European countries because it is so much weaker in character. This is due primarily to the freer use of water, and because population and industries are not so concentrated as in Europe. There is also a difference in the character of the rainfall which has its influence on the treatment of storm waters. Generally speaking, there is a greater intensity of rainfall in Canada than in England, even where the total precipitation is very much less. Unfortunately, the weakness of the sewage does not make its treatment for disposal, easier or cheaper nor does it lessen the chance of pollution of drinking waters.

Limitations of a Separate System of Sewers

A few years ago when the character of the sewage became known and when the question of the treatment of sewage began to receive greater attention it was felt that the best results would be secured if separate systems of sewers were installed. One system to take care of sanitary sewage only and another to take care of storm and surface water. Many installations were made on this basis but not many of them have given the service expected. It seems impossible to get some municipal officials to recognize the limitations of a separate system of sewers. It is an even greater task to get municipal authorities to support those officials who do realize these limitations, and thus it is that the majority of separate systems are abused, causing trouble to property owners, claims for damages and difficulties at the disposal plants. It must be accepted as a fact that property owners will not tolerate standing water in their cellars and that if the sanitary sewer is the only one available to drain away the water it will be used for this purpose, and when once used for other than sanitary sewage there is no limit to the abuse.

Most of the fast developing towns and cities so soon realised the limitations of sanitary sewers that the policy was changed and the majority of the larger towns are now sewered on the combined principle, with one sewer carrying both sewage and storm and surface water. The greatly extended construction of paved and hard-surfaced roads is, however, having its effect on sewer design. In many cases the extent of impervious area and the rapidity of run-off was underestimated and intercepting or relief sewers have had to be constructed.

The haste to construct paved roads in small municipalities has lead in many instances to the construction of storm water drains in advance of any sewers. This inevitably means that when the question of sewers is considered, separate sanitary sewers will be advocated. Probably the best solution will be found in the modification of both systems. With the increasing use of motor transport and the reduction of the number of horses using paved roads, the pollution of paved surfaces will not be as great as formerly, and there seems no reason why such water should not be discharged into streams and water courses rather than carried with sewage. It must not be forgotten that many legal problems arise when any diversion or acceleration of steam water is occasioned by the construction of artificial drainage systems, and engineers must be careful not to involve municipal authorities in expensive law suits. If surface water is thus diverted from the sewers the sanitary sewers might be enlarged to take care of basement and roof water, thus meeting the requirements of the property owners and greatly reducing the amount of storm water to be discharged at storm overflows, or treated at disposal plants and pumping stations.

There is a universal tendency to construct storm water drains at a shallow depth to save cost. It is not always true economy as it leads to endless complications with service connections, gas and water mains and electric conduits. There are few municipalities that have complete and easily accessible records of their sewer and drainage systems. There are far too many changes in engineering staffs and municipal administration to get records into proper shape. Time and time again when a conscientious engineer endeavors to secure this information he is denied the assistance necessary, or if it is at first granted it may be withdrawn before the work is completed, the authorities forgetting that by so doing they have practically wasted all the expenditure incurred.

It would be a measure of true economy if every municipality was compelled to file a complete record of their sewer and drainage systems delimiting the areas served. There is a constant tendency to stretch out sewer systems, even to extend them outside municipal boundaries without any understanding of what is involved. Many sewer systems designed under old conditions before the advent of paved and hard-surfaced roads are now inadequate, but by a careful resurvey and study of new conditions they may be utilized to good advantage by the construction of relief and intercepting sewers.

No Outstanding Changes in Construction

No striking changes in sewer construction have been made in recent years. Reinforced concrete has been used for the construction of large sewers but as the knowledge of the permeability of concrete has increased greater caution has been exercised in design ,and the duty of the steel has been somewhat limited. Experience will show to what extent corrosion and electrolysis must be guarded against.

With the growth of industry in Canadian towns' industrial wastes will create problems and the experience of older countries in dealing with this matter will be valuable. It must be taken for granted that the use of chemical agents in all industries will greatly increase. Even in what are regarded as strictly mechanical industries large quantities of chemical substances are now used and eventually find their way to the sewer and their action on the materials that enter into sewer construction must not be underestimated.

One of the most striking features in sewer construction is the careless way with which many municipalities allow service connections to be made. Care is exercised in sewer construction which is done under the superintendence of engineers and inspectors. Internal pumbing is generally done to a recognized standard, inspected and tested, but too often the connection between the plumbing and the sewer is allowed to be constructed by any handy man without supervision and test, and many expensive pavements will be greatly deteriorated because of frequent breakage involved in unstopping or repairing these faulty connections. Greater care in the supervision of sewers and sewer connections will repay the municipality by the preservation of paved roads, reduced liability for accidents and lessened interference with traffic.

The engineering profession as a whole can render a real community service by taking an intelligent interest in the public works of the municipality and especially those vitally affecting the public health. Much valuable help can be rendered to those who design or maintain these services if professional men will co-operate more freely.

The City of Ottawa's Latest Bridge

The Cummings Bridge, Over the Rideau River, is a Reinforced Concrete Arch Structure, 615 feet Long—Deck on a Grade of 2½ Per Cent —Cableway Used for Handling and Placing Materials

By the Contract Record's Ottawa Representative

Cummings bridge, the second of the new reinforced concrete arch bridges erected over the Rideau River, Ottawa, Ont., has just been completed, although opened to traffic for some time. The new bridge is the connecting link between the city of Ottawa and the country lying along the Montreal road in the county of Carleton, and replaces a steel structure built some 25 years ago and which had become unsafe for further traffic.

After the necessary agreements were reached between the city and the county, as to the location, design and cost of the new structure, instructions were immediately given to the city commissioner of works, Mr. A. H. Macallum, to proceed with the preparation of the necessary plans and specifications for the construction of a reinforced concrete arch bridge. This work was entrusted to Mr. Robert Henham, at that time bridge engineer for the city, but now consulting engineer for the Dominion Reinforcing Company, Ottawa. In May, 1920, a contract for the work was awarded to Mr. Thos. McLaughlin, contractor of Ottawa, the price being $331,000 for the work exclusive of the balustrade and lighting standards, the last mentioned items being made the subject of separate contracts.

The work was started shortly after signing of the contract and was proceeded with without interruption and without any unexpected delays through to its successful conclusion. The old steel bridge was kept on for light traffic during the erection of the new one, this being made possible by the decision of the authorities to slightly alter the location of the new bridge. One end of the old bridge was shifted some fifty feet in order to make way for the equipment of the new work. In doing this, the construction of a temporary bridge was avoided, resulting in a considerable saving to the municipalities concerned.

The new structure, which is designed for heavy traffic, consists of five equal arch spans of 100 feet, centre to centre of piers, and three shorter spans totalling 118 feet, between pier No. 5 and the west abutment. The bridge carries two street car tracks, roadways and two 5½ ft. sidewalks. The total length of the bridge is 615 feet, exclusive of approaches, while the width is 50 feet. The floor is built on a grade of 2.5 per cent, from the city side; this was done on account of the great difference in elevation of the two banks of the river at that point, thereby cutting down a great deal of the hill on the Ottawa side of the river.

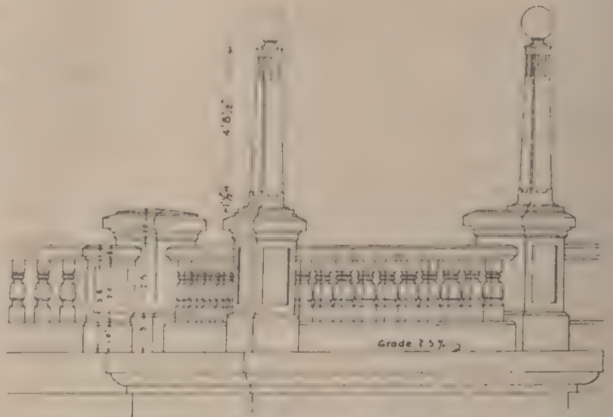


Fig. 2—Elevation of the balustrade and lighting standards at the piers

All excavation work as well as the placing of the materials was handled by cableway. For this part of the work, two towers were erected, one fifty feet and one sixty-five feet in height, placed 800 feet apart.

Substructure

The work was carried through expeditiously, this being facilitated by the quite uniform character of the foundation soil, solid ground lying a short distance below river bed. The east abutment and the four piers next to it rest on solid rock, which was struck at approximately six feet below the river bed. The remaining piers and the west abutment had, however, to be sunk down 12 feet to suitable foundations. The width of the piers are 12 feet, excepting pier No. 5, which is 20 feet wide. The three short spans on the west end of the bridge, between pier No. 5 and the abutment, are carried by rectangular columns resting on suitable

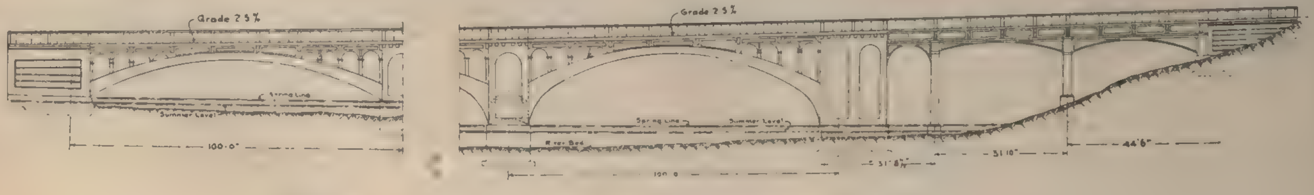
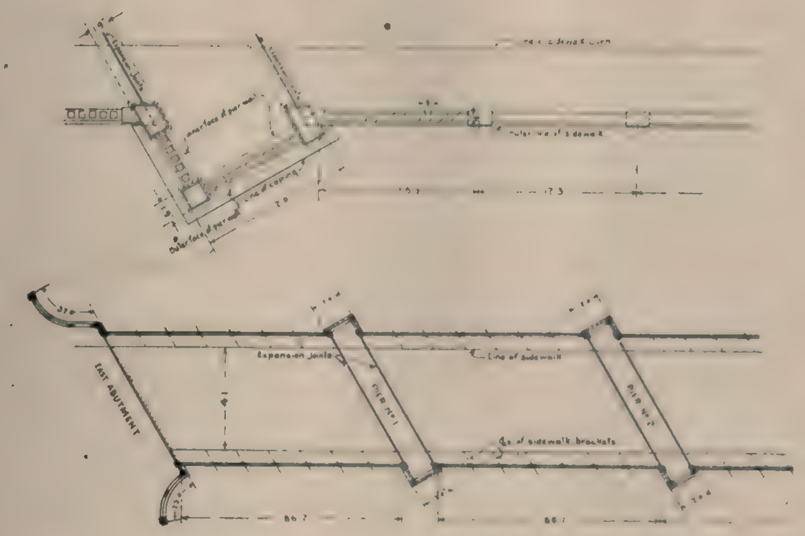


Fig. 1—Elevation of the Cummings Bridge, Ottawa



Figs. 3 and 4—Plan of part of the bridge (east end), showing the oblique piers.

footings. The piers and abutments are reinforced with ½-in. rods, placed at two ft. centres and staggered. The piers are provided upstream with a cut water of a V shape, slightly curved at the top.

Superstructure

The bridge's five spans are of equal length, 100 feet from centre to centre of piers, or 86 ft. 2 in. in the clear, and the distance between pier No. 5 and the west abutment is divided into two 32 ft. and one 46 ft. spans, as shown on drawings, Fig. 1. The arches are built in one section only and follow an elliptic curve, with a minimum rise of 11 ft. 9 in. for arch No. 1, to a maximum of 21 ft. 9 in. for arch No. 5, the rise increasing 2 ft. 6 in. in each arch on account of the 2.5 per cent grade of the bridge floor. The depth of the arches is 27 in. at the crown, but varies from 5 ft. 3 in. to 7 ft. 1 in. at the haunches, proportionately increasing from pier No. 1 to pier No. 5. Transverse walls the full width of the floor slab and with which are cast the cantilever beams carrying the sidewalks, support the floor system. The floor, which is of the ordinary arrangement of slab, stringers and beams, is depressed for the width of the street car lines to make space for the tracks. The floor slab has a thickness of 6½ in. under the roadway and 7 in. under the car tracks. The pavement which measures 41 ft. in width, consists of creosoted wood blocks laid on asphaltic waterproofing. The balustrade, of which there are 1,498 lineal feet, is artistically designed, as well as the lamp standards. Both are made of reinforced sandless concrete. The finely broken dolomite used in the aggregates, varies slightly in color from gray to white, and presents a very favorable appearance. The balustrade posts are placed at an average interval of 12 ft. 3 in. The cost of the balustrade was $13,474 and that of the lighting standards of which there are 28, $1,800.

A feature in the design of this bridge will be noted by referring to illustrations 2, 3 and 4. The designer must be given credit for the good idea of making use of the available space on the part of the piers extending beyond the bridge floor, this due to the fact that the piers are at an angle with the centre line of the bridge. The balustrades and sidewalks are carried around the extreme ends of these triangular portions

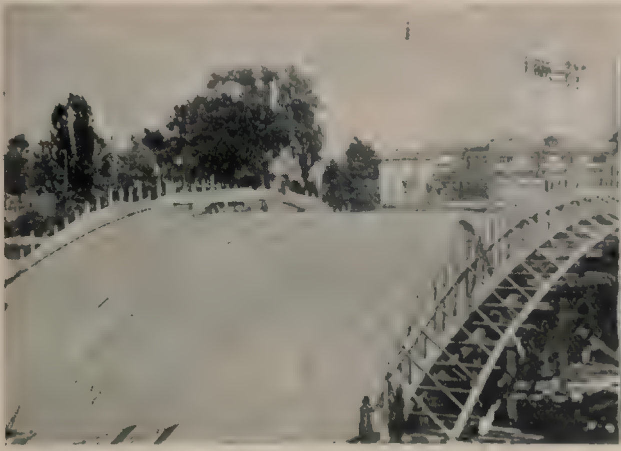


Fig. 5—Falsework on arch No. 4 ready for arch reinforcement

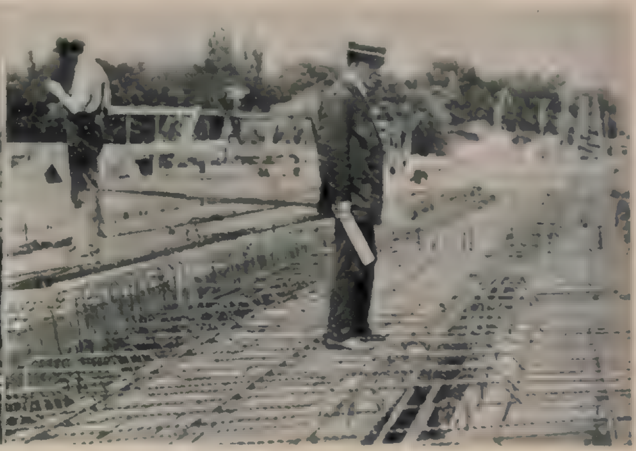


Fig. 6—Reinforcement of arch No. 2

of the piers, using this surface for rests or platforms of observation. This feature is puite worthy of mention. It is clearly shown on Figs. 2, 3 and 4. The arches were designed to carry 15 ton motor trucks on the roadways, and the largest double truck street cars, 31 tons, on the trolley tracks, The permissible stresses in the concrete were taken at 650 lb. per square inch compression and 16,000 lb. per square inch tension in the steel.

Quantities Involved in the Construction

Approximately 10,000 cu. yds. of concrete were used in the work together with 330 tons of reinforcing steel. The mixture for the piers and abutments was 1:3:6 and 1:2:4 for the reinforced concrete. The reinforcing consists, for the arches, of one inch square twisted bars, longitudinally, and transverse rods 3/4 in. in diameter and ½ in. stirrups; for the slab, ½ in. rods in both directions; ½ in. rods for the cross walls and ½ in. twisted bars for the floor beams, stringers, and cantilever brackets. Expansive joints are located at piers and abutments. All surfaces seen in the elevation are finished by bush hammer, which work was done immediately after the removal of the forms. The falsework for the arches was carried on piles. Concrete mixing and crushed stone plants, as well as a completely equipped carpenter shop, were installed on the site of the work. The mixing plant consisted of a one cu. yd. mixer and a capacity of 25 cu. yds. per hour, and of storage bins of a capacity of 200 cu. yds of stone and 100 cu. yds of sand. The cost of the bridge and land damages in connection therewith were borne equally by the city of Ottawa and the county of Carleton, each paying 50 per cent., excepting the sidewalks and balustrade, which were built at the city's expense.

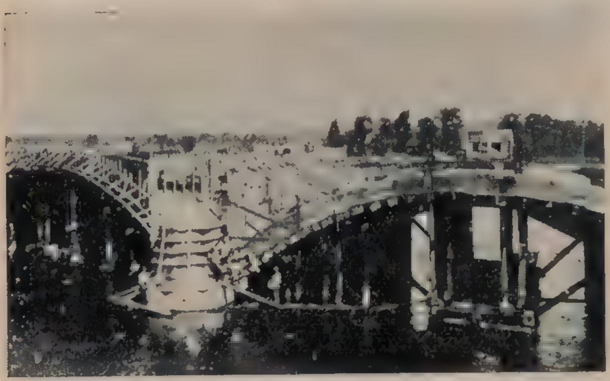


Fig. 8—Arches Nos. 2 and 3 during construction

Mr. G. F. Taylor, bridge engineer, supervised the construction of the bridge, with Mr. W. Legault as assistant.

Paints and Oils Have Touched Bottom

The great amount of building activity this year, and more particularly the large bulk of residence and industrial building which reacts on the paints and oil market to a greater extent than any other branches of construction, has made for an active year in the market for these materials. According to one prominent paint manufacturer the business this year will exceed in volume that of 1921, but, owing to the lower prices prevailing this year, the increased value of business will not indicate the increased volume. This applies to nearly all lines of paints and varnishes. Prices have evidently touched bottom our informant goes on to state, in fact increases have been registered in certain lines recently.

Though the general tendency in the prices of paints, oils, turpentine, etc., has been down this year, there was considerable fluctuation, more particularly in the price of oils. In the case of oils, this fluctuation is explained by the fact that the price of the seed, which determines the cost of oil, changes from day to day. This particular manufacturer looks for another busy season next year.

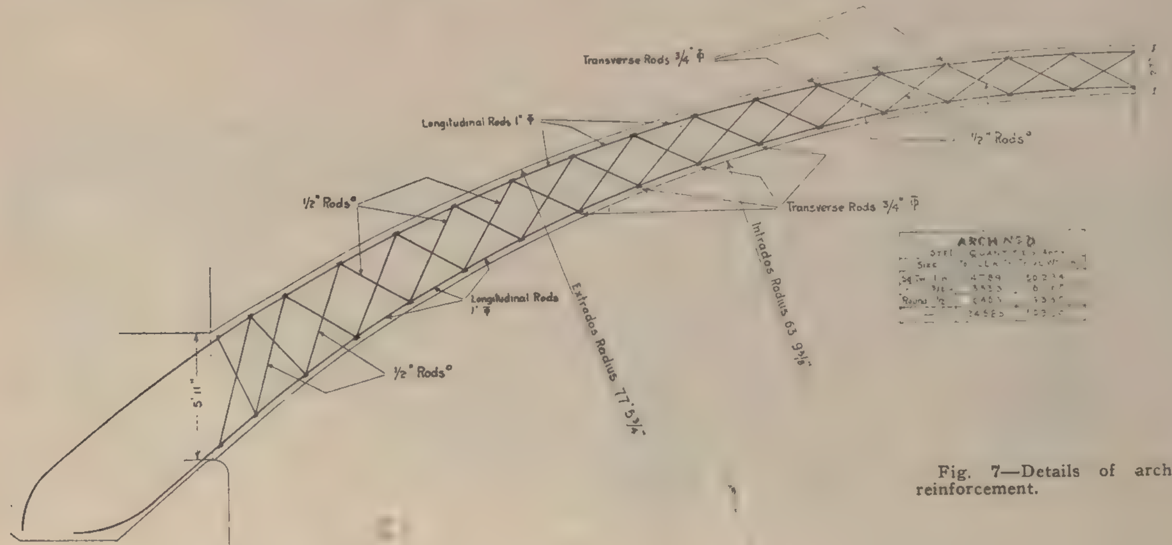


Fig. 7—Details of arch reinforcement.

The Baron Byng School Typical of Montreal's New Educational Institutions

The Second Largest Protestant School in Montreal Has Incorporated in it Several New Features That Make it One of the Finest Buildings of its Kind in Canada

By the Contract Record's Montreal Correspondent

At very frequent intervals the Montreal Protestant Board of School Commissioners find themselves confronted with the necessity of providing more schools to satisfy the rapidly growing demand for education. Montreal parents, realizing as they do its value, have been sending their children to school without much urging, thereby creating a condition of congestion in the schools which has taxed the ingenuity of the Board to provide accommodation for. During the past several years the condition has been most noticeable at the High School on University St., which was only completed about 4 years ago. This is a very large building and, at the time, it was thought that it would be ample for some time to come. But, since then, the School Board has had to provide more room for those desiring to attend High School grades.

The Baron Byng School is situated on St. Urbain St., a short distance above Pine Ave., in a very densely populated district. The district round about it is almost exclusively inhabited by Jews; probably 90% of the students of this new school are members of that race. All this large body of students was formerly obliged to go much further to schools that were already crowded. Indications are at present that this new school will also be taxed to its capacity before very long as it serves a large territory. The limits of this territory are as follows: bounded on the west by Park Ave. and its continuation, Bleury St.; bounded on the east by St. Denis St.; on the south by Craig St.; and on the north by Villeneuve St.; comprising an area of about 1½ square miles.

General Description of School

The new school consists of 3 stories and part basement laid out in the shape of a U, the upright legs of the U representing two wings, one along Clarke St. and the other along St. Urbain and joined by the third wing which runs through from Clarke St. to St. Urbain. The total over all lengths of the wings on St. Urbain and Clarke Sts. are 168′-0″ and the length of the one across the block is 235′-0″. The width of those on Clarke and St. Urbain is 71′-0″ and the one across the block is 40′-0″ wide.

The foundations and general design are such as to provide another storey to be added as soon as the need for such is realized; it appears just now that this additional space will soon be needed. There are two entrances from each side, the girls' entrance being from St. Urbain St. and the boys' entrance from Clarke St. There is also a fifth or main entrance from St. Urbain St. for teachers and others having business at the school.

The walls are of brick, face brick being Citadel brick and backing brick regular plastic brick. All walls are lined with terracotta. There has been considerable cut stone introduced into the construction at various points to relieve the monotony of the brick walls. This stone is Montreal Limestone which is found in large quantities round about the city and is very adaptable for building purposes. It presents a pleasing appearance when finished and resists weathering.

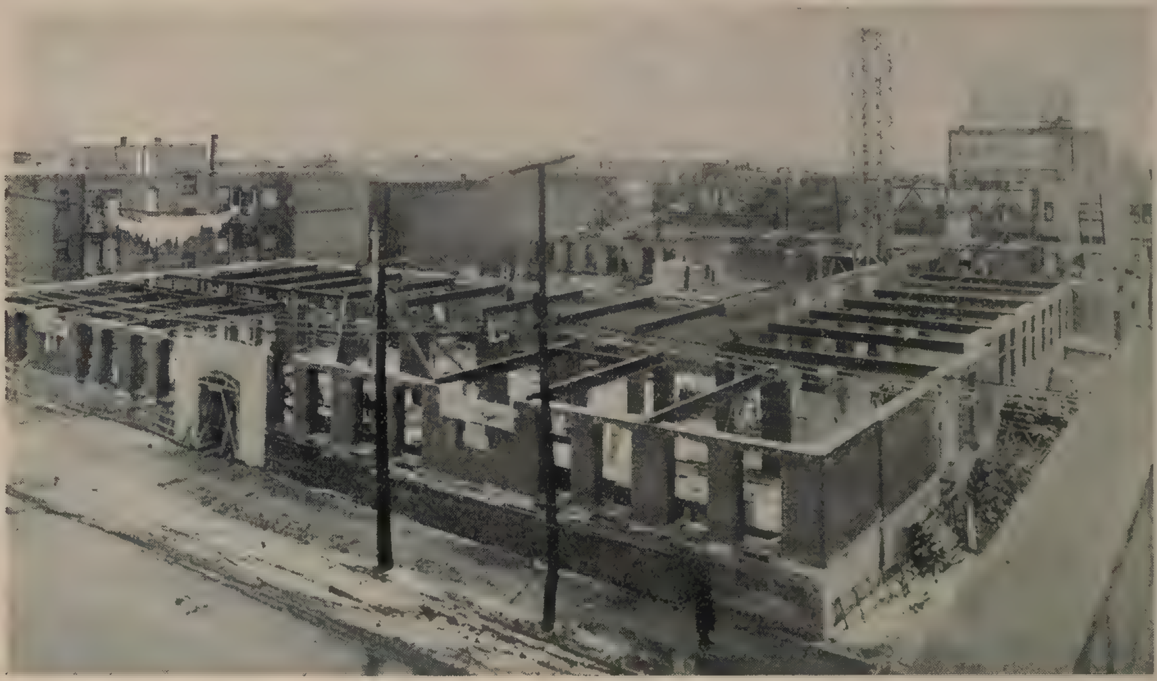
Playground Areas Small

The outside playground area is relatively small considering the number of students who will attend the school. This was due to the fact that property in such a densely populated district was necessarily high in price and the Board had to provide a large building to accommodate the number who would be attending. The playground to the south is long and narrow, running through from Clarke St. to Urbain St. at an average width of 30'. The one to the north is about the same width but has a deep indentation between the wings of the building up to the wall of the gymnasium. This indentation or court is about 93' x 60' and provides considerable extra playground space. These outdoor playgrounds are paved with asphalt, instead of cinders or fire stone, to eliminate as much as possible the carrying of dirt into the school.

Girls' and boys' locker rooms and shower baths have been provided at each end of the room, with mastic floors throughout, and marble divisions between the showers. It is also proposed to use the gymnasium as an assembly hall and for this reason another large room opens off the gymnasium which is used as a storage for chairs.

The gymnasium of the Baron Byng school

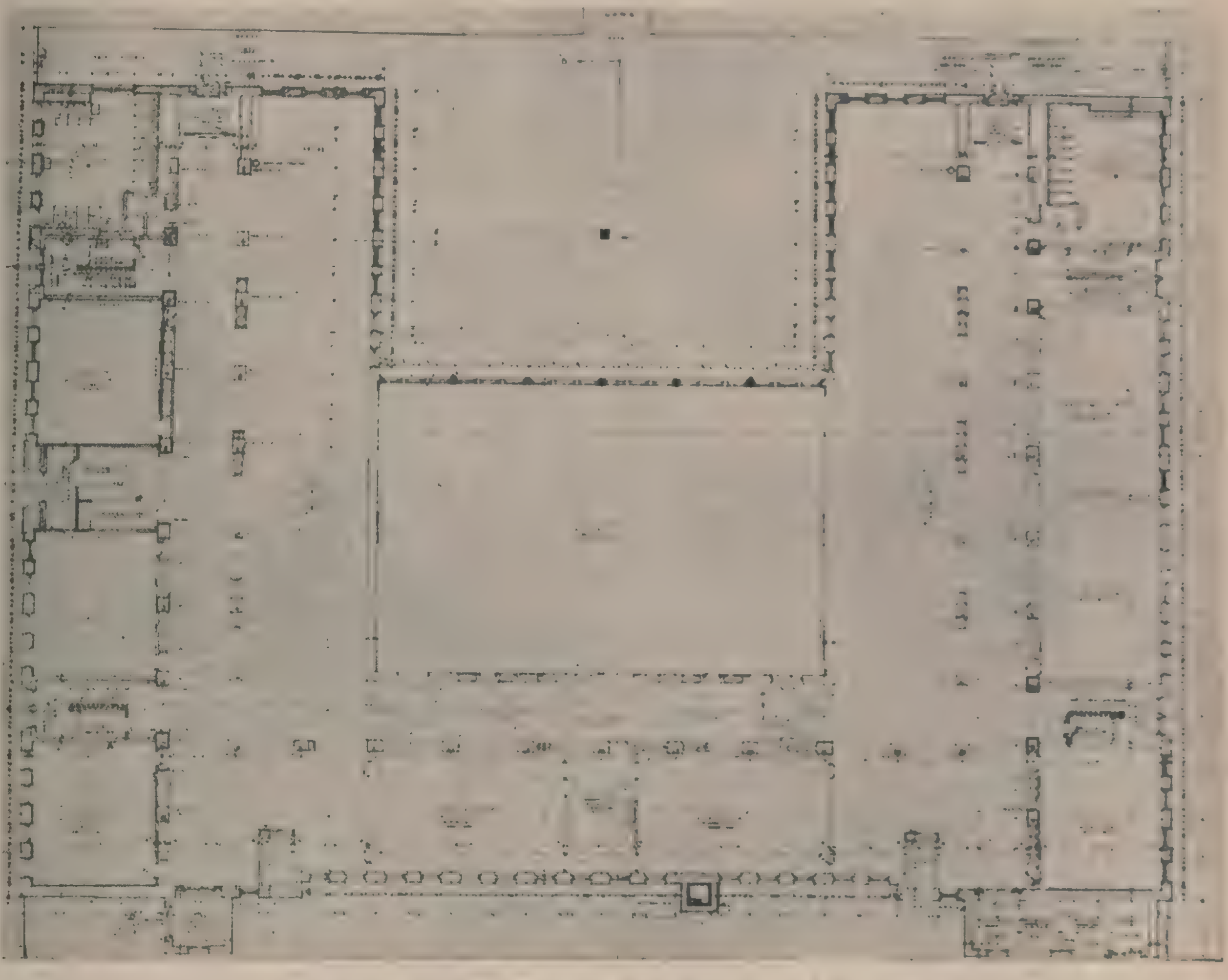
There are two large lavatories provided on the ground floor one at each end of the wings. The one in the St. Urbain St. wing is for the girls and the other one in the Clarke St. wing is for the boys. There are other smaller lavatories and washrooms in other parts of the building and they are all equipped with thor-



Floors of the Baron Byng school in Montreal are of the Siegwart beam type carried on heavy steel girders oughly modern apparatus. The smaller lavatories are lined with white tile and the larger ones with white enamel brick. All lavatories, both large and small, have Terrazzo floors, and have marble divisions to assure privacy.

The Library

There is a large library, 60′ x 27′, on the first floor up, which has been installed mainly for the use of students. It is furnished with solid oak chairs and tables as well as magazine racks and bookshelves and should be a very welcome addition to the general recreation facilities of the school.



Ground floor plan of the Byng high school—John S. Archibald, architect

The principal's office, lady teachers' rest room, men teachers' rest room and doctor's office are also on the first floor. Each room has a private lavatory adjoining as well as lockers and storerooms. The rest rooms are very comfortably furnished; books and magazines are supplied.

Thirty Lecture Rooms

There are 30 lecture rooms in the school distributed as follows. The ground floor has 3, the first floor up has 15 and the top floor has 12. They are all the same size, 25′ x 30′, with a large cupboard in one corner which is used as a store-room for materials used in the lectures. There is also the usual blackboard and exhibition rail. The floors are of selected birch laid directly on cement.

Other lecture rooms which are devoted entirely to one subject are distributed throughout the school on the three floors. The top floor has the sewing room and cookery room for girl students only; also physics and chemistry lecture rooms, physics and chemistry laboratories, and physics and chemistry preparation room. The laboratories and preparation rooms all have red quarry tile floor, instead of wood, in case any mishap should occur either in the preparation or the conduct of an experiment. The chemistry preparation room is fitted with a fume chamber lined with white tile and having a blower to drive off the offensive gases which so often follow an experiment in chemistry. Modern apparatus has been installed in all these special rooms mentioned. There are no special lecture rooms on the first floor up, but the ground floor has a large electrical room and two woodworking rooms.

The Principal's Office

It is interesting to note some of the electrical-mechanical devices in the principal's office. There is an electrical master clock which controls the clocks in all the other rooms of the building, thus automatically synchronizing all clocks. All fire bells and calling-in bells are worked from this same office and a mechanical control on the wall gives the temperature of the air in the classrooms and corridors. This latter device is used in conjunction with a mechanical ventilation system of supply and exhaust which provides every room in the building with circulating fresh air. A system of air washing and automatic mixing admits of reusing the exhaust air which is mixed with a carefully regulated supply of fresh air which is brought in at the roof level.

Heavy Steel Beams Carry Load

The floors throughout the entire building are carried on heavy steel I-beams bearing directly on the outer walls and intermediate columns. The steel I-beams have concrete haunching to render them fire-proof.

Siegwart beam construction is used over the entire floor area of the building.

The roof is a Barrett Specification roof laid by Campbell, Gilday, Co., Ltd.

Future Needs

The foregoing description will give readers a clear idea of the general features of Baron Byng High School. It is the second largest Protestant school in the city of Montreal. The architect, in collaboration with the School Board, has introduced several new features into the construction which make it one of the finest schools in Canada. The physical comfort of the students has been a prime consideration of the Board, as elaborate facilities provided for their mental improvement. All those who contributed in any way towards its design and erection are to be congratulated.

The Latest in Sand-Lime Brick Plants

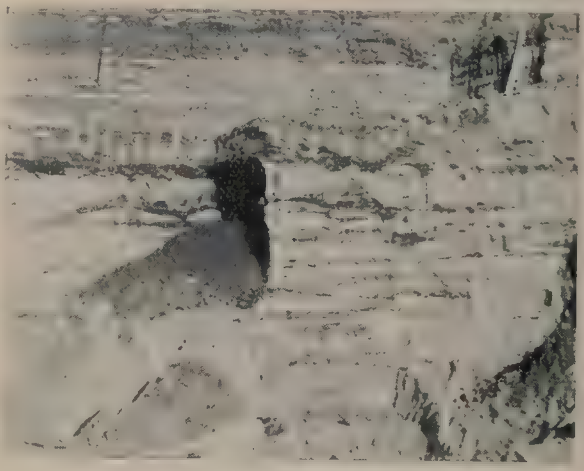
A Description of the New Facilities and Equipment of the Don Valley Brick Works, Toronto

The Don Valley Brick Works of Toronto, Ontario, have what is considered by many as the most interesting deposit of brick making materials on this continent. The formation of this deposit is as follows: 40 feet of clay at the top which is used for making buff common brick; then 65 feet of buff burning clay for making dry pressed, wire-cut brick and hollow building tile or fireproofing; then 20 feet of pure silica sand from which a high grade sand-lime pressed brick is now produced: then to a depth of 75 feet the best Hudson shale for making red dry pressed brick. Numerous colors and shades are produced by mixing these materials.

Sand-Lime Brick Now Produced

The strata of sand has up to the present been a great source of expense, because it could not be utilized in making clay or shale brick. A thorough test, however, revealed the fact that this sand would produce a high grade sand-lime brick and the growing demand for this form of brick induced the firm to install the most efficient, economical and up-to-date machinery for its manufacture with the result that they now have a capacity of 22,000 sand-lime brick per day.

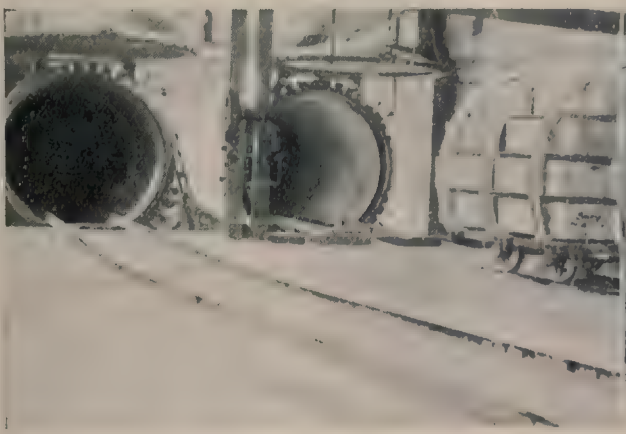
There are four very essential points in producing a high grade sand-lime brick, viz., the thorough hydration of lime before being made into brick form, the proper percentage of lime and sand, the highest pressure to form the brick and the elimination of manual labor to attain these results consistently without any variation.



Sand bank at the Don Valley Brick Works, showing formation of material

The raw lime is hydrated by steam at high pressure by the patented system of the Berg Machinery Co., which consists of small steel boxes each containing 50 pounds of lime, which are placed on rack cars holding 22 boxes on each car; the hydrating cylinder is filled with these cars, sealed tight and subjected to a pressure of 60 pounds for four hours, after which operation the hydrated lime is pulverized to dust and elevated into a large storage tank, which holds two days' supply and is then ready to be mixed with the sand.

The sand is conveyed from the sand bank by dump cars to the plant, a distance of about 200 feet, and dumped into a large hopper where the sand is fed automatically into a large revolving steam sand dryer which drys the sand practically bone dry. It is then elevated and screened to remove the clay and stone; the dryed sand is



Hardening and hydrating cylinders, with hydrating cars on the right

Steel car loaded with brick. Four mould Berg brick press in the background

then discharged into two large storage bins holding six days' supply—this allows the use of cold sand which is preferable to the hot.

The Mining Methods

The hydrated lime and dry cold sand are fed by gravity into an automatic proportioning machine, which measures in small quantities the proper percentage and discharges into a continuous mixer mixing these materials in the dry state. The mixture then passes to another mixer where the required amount of moisture is added. A bucket elevator then delivers the material into a 4-mould Berg brick press; the pressure on the brick can be regulated at each revolution to give the brick the extreme pressure at all times.

The bricks are handled by two men and placed on steel cars holding 1,000 bricks each, and when the day's run is finished the cars loaded with green bricks are pushed into a hardening cylinder, 76 inches in diameter and 72 feet long made of 5/8 inch steel plate and having hinged doors on each end; when filled and sealed the bricks are subjected to a steam pressure of 125 pounds for ten hours.

The hardening bricks are taken out of the other end of the cylinder while on the cars and are then ready for shipment, the whole operation being accomplished every 24 hours. The plant is equipped to run every day in the year, winter or summer and in wet as well as dry weather, which insures a definite supply to the customers at all times.

This plant consists entirely of machinery and equipment made by Berg Machinery Co. of Toronto, Ontario, and was designed and installed under the personal supervision of Mr. John Berg.

What of The Lumber Market ?

The Industry as a Whole is Sounder To-day Than It Has Been Any Time Within the Past Two Years—How Prices, Demand and Stocks Have Acted During 1922 and Their Probable Future Trend

By G. B. Van BLARICOM
Editor, "Canada Lumberman"

It has been said that it is safer and more satisfactory to view business on the long-pull basis than to attempt any detailed analysis of current conditions. This is particularly true of the lumber industry which is of a speculative character, demanding faith, vision and courage of the higher order. From the time of the felling of the tree to the marketing of the finished product, often two or more years elapse, and within that period there may be changes—industrial, commercial and financial—that no one would ever think of. Lumbering is ever a long-range game and of such a hazardous character, financially and otherwise, that changes do come rather suddenly. These are often the result of wide co-operation, growing markets and maturing confidence, and all are evidenced in the trade at the present time.

The outlook for the coming season is considered promising, and everyone connected with the calling is optimistic, believing that 1923 will be a year of normal activity and steady trade. Lumbermen now recall with a shudder the early days of 1920 when there was a runaway market and auction prices held sway. Then came the awful reverse when wholesalers and producers were caught with heavy stocks on hand and contracts were cancelled on all sides. Everybody sought to unload at once and no person wanted to buy. Prices dropped from 40 to 60% and many were not able to liquidate their holdings.

But that is another story. It was not until last spring that the last of the high-priced wood goods had been converted into cash, in most cases at a heavy reverse to the owner. The new cut then came on the market on the basis of the lessened cost of production; operators were able to base their costs on something definite and proceed with the knowledge that their footing was safer and their pathway clearer. All guesswork had been eliminated and all losses practically absorbed; trade was increasing and matters generally were headed in the right direction.

To-day everything betokens a good year. Stocks are low, in many cases from 20 to 50% less than what they were twelve months ago. The demand is widening and construction is likely to continue on a big scale throughout 1923. Interviews with representative lumber manufacturers, sawmill equipment concerns and firms which supply hardware, harness, belting, tools, etc., in the lumber line, all tell a distinctive story of good times being under way and a period which will be marked by higher prices on some woods and possibly develop in others a shortage in certain widths and thicknesses.

Last year was certainly a soft-wood year. This was caused by the large amount of houses and store buildings which was carried on in the greater centres of population. There was not much doing among the larger industries which consume hardwoods, both native and imported, until the early fall. What business developed during the first half of 1922 was with the automobile trade and large consuming centres across the border, the demand at home being very quiet. This aspect of affairs has now been changed and those who are getting out stocks for the coming season report that they have numerous inquiries regarding the extent and disposition.

* * *

There is every reason for belief that normal conditions in the industry are now at hand. The wide spread in prices on oak, birch, maple, ash and elm has decreased and all elements of a speculative or uncertain nature eliminated. The growing production and sale of hardwoods, the increasing activities of agricultural implement firms, the better outlook in the furniture line and the heavy car equipment that will be called for by the railways, all portend that 1923 will witness a consistently growing volume of trade. Continued building operations will also create a demand for softwoods and there is no perceptible evidence that a falling off will take place in structural activities. On the other hand, retail lumbermen are of the opinion that spruce, jack pine, red and white pine and other woods will enjoy just as active requisitions during 1923 as they have within recent months.

There was in 1922 a good market for hemlock, which in certain lengths became very scarce and jack pine and spruce and western fir were substituted wherever possible and economically profitable in studding, joists, small dimension, etc. The rural retailer, however, did not fare as well as the city dealer. Owing to the low price of produce and live stock; farmers hesitated about making any repairs or extensions to their dwellings, and it was only when assured of a bumper crop that they began to "patch up." The housing needs of many cities are not yet adequately met and rents remain at a high figure.

It has been asked if so many companies entering the bush this winter and manning camps will not result in an over-production that will set things back in a way that may be viewed with a certain degree of foreboding. It may be stated that the supply of lumber is growing less each year while its consumption is increasing. The sources are farther and farther removed and the various items which enter into the driving, towing, rafting and other work are climbing in cost. Wages show no tendency to decrease and the efficiency of men is not as high as it was before the war. It is true that woodsmen can be boarded cheaper than a year ago but this is a small factor compared with the growing outlays in other directions.

* * *

The lumber industry as a whole is sounder to-day than it has been any time within the past two years. Interviews with representative men in various parts of the country speak hopefully of the export outlook, the industrial awakening in the Old Country, the heavy constructional programmes planned in many cities and the ever-widening use of wood products which are not being supplanted by any patent preparations or substitutes.

The total of exports from British Columbia for the first nine months of 1923 amounted to 195,000,000 feet, an increase of 73,000,000 feet as compared with the corresponding period of last year. Business with California and the Atlantic coast was very good, and was largely responsible for the size of the total. The prospect is for further trade with the Orient and Australia, and lumbermen are looking forward with much encouragement.

The lumber cut this winter will be heavier in practically every province than it was last season; the increase is variously estimated from 10% to 40% over what it was last winter. Stocks in mill yards are, however, moving out and inventories will show that producers have many million feet less on hand than they had at this period last year. By some it is thought there may be a shortage of dry stock early next spring as lumber to-day, either in hardwoods or softwoods, is in fewer hands than it was some months ago.

The Brick Situation Analyzed

A Great Many Factors Enter Into the Manufacture of Bricks and Affect Their Price—1923 Market Conditions Depend on the Volume of Construction and the Cost of Labor, Fuel and Freight

There is a term used very frequently in the electrical industry. It is **Load-Factor.** A higher load-factor is the constant aim of the management of every electric generating and distributing plant. It means greater revenue without increasing operating costs.

The same is true in a very high degree of the Brick Industry.

Load-Factor may be defined as the ratio of actual production to capacity production If the capacity of a plant is fifty thousand bricks a day and the actual production, due to limited demand, or other cause, is only ten thousand bricks, the load-factor of this plant for the time being is only twenty per cent. When the production, due to increased demand, rises to twenty-five thousand bricks per day, the load-factor becomes fifty per cent, and so on.

It is plain that many of the items that enter into the cost of operation of this plant are exactly the same in each case—management, clerical staff, maintenance, sinking fund charges, insurance, and the various items generally included in "overhead" are practically identical—but the gross income in the latter case is two and one half times as great as in the former.

The Kilns Deteriorate

As a matter of fact certain items in the overhead expenses in a brick plant are greater when the plant is idle. For example, the kilns depreciate more rapidly when not in use and the finished product deteriorates.

Another factor in the brick industry that complicates operation is the varying production capacity during the year. In the summer many smaller plants are put in operation—chiefly to supply local needs. These close down with the approach of cold weather, leaving the load—which may be large or small, depending on building activities—to the few plants that are equipped to operate the year round.

The difficulties of brick manufactures have been accentuated during the last few years by two other causes that bulk large in the cost of manufacture—increased cost of (1) labor and (2) fuel.

Apportioning the Cost

In a general way it may be said that the cost of manufacturing brick is proportioned as follows:—labor, one third; fuel, one third; management, etc., (overhead), one third. It will thus be seen that the increased prices of labor and coal, which for the time being at least seem to have become standardized on a very much higher level, are insuperable obstacles in the way of getting back to pre-war prices.

As in other lines of trade, labor costs have shown little tendency to decline. A year ago when unemployment was so much in evidence the men were willing to accept less, temporarily, but during the present season, with the demand often in excess of supply, wages have again been advanced.

The history of coal prices is too well-known to all of us to require more than a mere mention. Coal at the mine was formerly $1.00 a ton, and is now at least $4.50; duty adds another 53 cents; freight per ton, formerly 2.25 is now 3.74; this makes a total cost per ton laid down as $8.77 to-day against $3.78 in 1913.

And it takes a minimum of 1,200 pounds of coal to make a thousand brick.

The Cost Curve

The above items indicate in a general way the problems of the brick manufacturers. They will explain why the cost of brick has necessarily increased during the period 1913—1922. During most of this time the demand was very limited and the industry was confronted with both a poor load-factor and rising costs of labor and fuel. This will explain the vagaries of the curve shown elsewhere and the steady up-grade from 1916 to 1921.

That this curve did not continue its upward trend during 1921 is due largely to the determination of brick manufacturers to take losses in an endeavor to stimulate building.

The downward tendency during 1922 shows the result of a greatly increased load-factor i.e., plants were operating at full capacity during the past summer.

The price of bricks for 1923 cannot be gauged at the moment. If the demand is good and labor plentiful, and if the tendency in coal and freight costs is downward, manufacturers, following a good year in 1922, may see their way to make further price recessions.

If another coal strike in the spring—of which we already hear mutterings—should materialize; if labor's demands should delay a reduction in freight rates, the price curve for bricks may take a turn upward. This would be most unfortunate, as it would tend to curtail the demand, thus again reacting on itself by creating a less favorable load-factor.

What the brick manufacturer needs during 1923, to place him on a firm foundation,—and this is true of practically all other manufacturers connected with the building and construction industry—is increased construction activity; sufficient labor supply, and lower coal costs and transportation charges.

$100,000,000 Worth of Houses

Canada's Record for 1922—More Homes Built and More Money Spent This Year Than Last—A Number of Extensive Housing Developments

Housing has easily maintained its place this year at the top of the list as the most important branch of the construction industry in Canada, from the viewpoint of volume of money invested, it being safe to predict that the year's total will be over $100,000,000, or, approximately 30 per cent. of the total value of all lines of construction. This huge figure will represent the construction of well over 20,000 residences, of all types. These figures indicate a substantial increase over 1921 figures, the number of houses erected last year being slightly over 16,000, at a total cost of $76,655,400. An important point, too, to be taken into consideration in comparing this year's and last year's figures, is the fact that building costs have been somewhat lower this year, the government index for October this year (the latest available) being 183 compared with the average figure of 216 for the year 1921, these index figures indicating the relation to the cost of building in 1913, which is represented by the base figure of 100. Figuring along this line, the money invested this year will represent a considerably greater volume of construction than indicated by the advance in monetary value.

Another pleasing feature in connection with this year's activities in house building is the fact that this increased production has not been localized, but practically extends to every section of the Dominion. The shortage of low-priced homes experienced by reason of the falling off in this type of construction during the war period has been to some extent alleviated by this year's increased activity and the prospects for the next year are such as to ensure further advance toward the ideal of adequate housing accommodation of this type. Although several of the provinces this year suspended government loans for housing, a great number of privately controlled schemes were put into operation by various private companies, at various points throughout Canada, and indeed, these developments have been responsible for a great number of residences of the smaller type.

Houses in Ontario

Ontario's total of new houses for the period from January to November of this year, inclusive, (actual figures for the whole year being as yet unavailable) far exceeds that of any other district of the Dominion, the number of homes constructed being 11,082 with a total value of $56,388,500. Quebec province is second with 4,057 new homes, valued at $23,910,700 for the same period. The total number of houses erected in the four western provinces for this period is 3,846 valued at $14,194,100, and the Maritimes accounted for 701 new homes, during these eleven months, costing $3,181,900. These figures in each case exceed the total for the entire year of 1921, which are as follows: Ontario, 9,451 houses, valued at $44,565,200; Quebec, 3,147 at $17,093,200; western provinces, 3,180 at $12,603,000; and the Maritimes, 505 at $2,394,000.

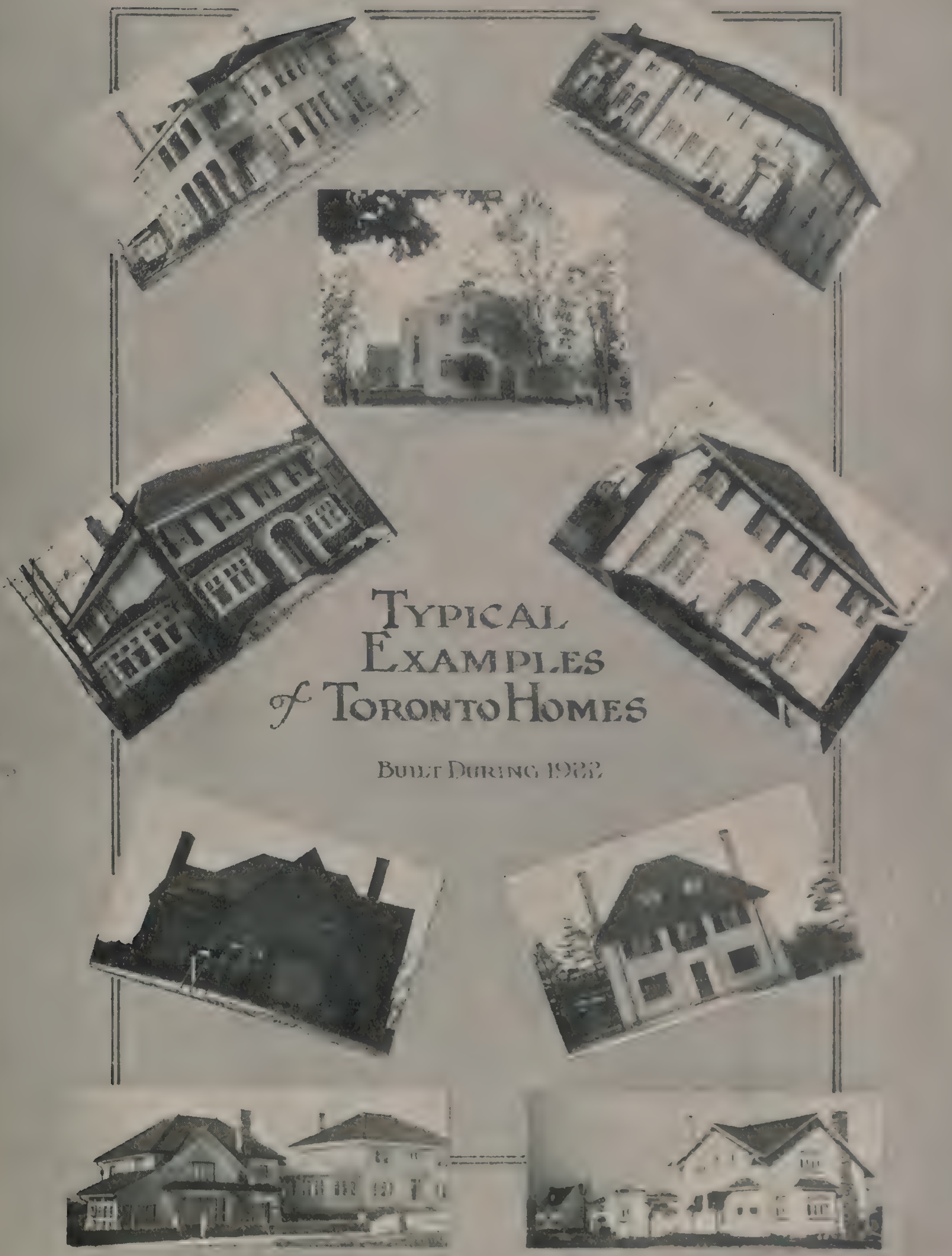
The great demand has been, of course, for the lower priced home and this type has constituted the large bulk of this year's program, but a great number of better class, more expensive homes have been erected, too, chiefly in the larger centres. A few of these better-class homes, ranging in cost from $10,000 to $50,000 are included among the illustrations on the following pages. A few residences costing even more than the latter figure have been erected in Ontario and Quebec this year. A type of house fast growing in popularity in Quebec province, and more particularly in the city of Montreal and the surrounding district, is the two and four-family residence, illustrations of which are also shown on the following pages.

Slight difficulty was experienced towards the close of the season in obtaining some lines of brick, more particularly the common interior brick, but this condition was hardly serious enough to greatly hamper house building. Many brick manufacturers have indicated their intention of extending their plants to look after the huge demand anticipated next year.

Many extensive housing developments have already been projected for next season and if we are favored with favorable material and labor conditions and a good long season, such as has been enjoyed this year, there is every reason to look for an even greater volume of house construction than the present year has produced.

A great number of housing developments were carried out during 1922 by various companies throughout Canada, for the greater part comprising houses of moderate cost. Ontario was especially active in this respect, though many extensive developments were also undertaken in Quebec province. More detailed reference to some of these privately controlled developments is given herewith.

Messrs. Horton & Smith, builders and contractors of Hamilton, Ont., have under construction several detached residences on Cros-



TYPICAL EXAMPLES of TORONTO HOMES

BUILT DURING 1922

thwaite Ave., in that city, a few of which are illustrated herewith. These houses are all identical in interior layout, but those with the gable roof have two rooms upstairs. They are all of brick veneer construction and sell for from $3,000 to $3,500.

One of the busiest house building centres in Canada is Haileybury, Ont., and the surrounding district, the scene of the disastrous forest fire last summer. Over 100 homes are under construction here. These homes are being built and located according to plans prepared by competent town-planning engineers. The Ontario Government has loaned the town $300,000 for rehabilitation purposes and is supplying every victim, who makes proper application through the relief committee, with 3,500 ft. of lumber.

Another important development is that of the Imperial Oil Limited, at Ioco, B. C. The company established a townsite at this point in 1920 and during that year and the year 1921 a total of fourty-four residences were erected and fifteen houses were moved from a location near the company's refinery to new sites on this townsite. During the present year nineteen new houses have been completed, bringing the total to seventy-eight modern dwellings. The provincial government has erected a standard rural school, capable of accommodating one hundred pupils and this, with a community hall, a general store, post office, drug store and pool room, complete a modern, picturesque town. The accompanying illustration will give some idea of the type of homes built here.

A colony of moderately sized, attractive homes is gradually being established through the enterprise of the Hudson's Bay Company on its reserve in the vicinity of the J. A. MacDougall School, Armoury, and High School at Edmonton, Alta. Eighteen well-built, moderately sized homes have been erected on lots having a frontage of fifty feet.

According to city statistics at Quebec, over 320 houses have been built this year, under the government housing scheme in that city, representing an investment of $1,796,710. These will probably supply accommodation for from six to seven hundred families.

At Three Rivers, P.Q., 154 houses of the tenement type have been built during the past ten months, representing an investment of $414,265. This activity is credited to the large amount of industrial development at this point during the year. Practically all the dwellings were semi-detached with one to three tenements and were constructed of wood framing, brick sheathing and finished inside with lime and sand.

At Lachine, P.Q., where the sum of $100,000 was borrowed this year for house building, five detached and two semi-detached houses have been completed.

The Keelefair Construction Company, Manning Chambers, Toronto, carried out a successful program of house building during the past year, comprising about 25 houses in all, in the Keelesdale district of Toronto. A few examples of the types of homes erected by this company are shown herewith. They are four and five room houses of brick and stucco construction and all are built on alternate lots, giving the purchaser an opportunity of acquiring an extra 25 ft. of land adjoining his home, if he desires to. These homes range in value from $3,600 to $4,750 and are modern in every respect. This company also erected in this district two stores, incorporating a six-room dwelling and another store with an 8-room dwelling. These are valued at $8,000 each. This company is planning to erect 50 homes in this district next year.

Mr. S. B. Green, builder, of Toronto, recently completed the fine row of duplex houses in the illustration herewith and also several large expensive homes on Austin Terrace and other streets in this district of Toronto.

Messrs. Churchill & Morrell, builders, of 639 Woodbine Avenue, Toronto, built 28 bungalows this year on Strathmore Blvd., Toronto. These homes are all of the five and six room type, of solid brick, and range in price from $7,500 to $9,500.

Messrs. Grimshaw Bros. were another active building firm in Toronto this year, a development consisting of 12 pair of six-room brick residences having been carried out by them on Glebeholme Blvd. in the Danforth District of Toronto. These homes sold at $6,000 each and are all occupied already.

Mr. Brook Sykes, well known Toronto real estate man, built 16 homes on Rogers Avenue and Louden Road, in that city, during the past year. These were all six and seven room houses and sold at $6,000.

The Rockland Housing Company, during 1922, undertook a development involving the construction of 52 houses, financed by a government load of $200,000, at the new Mount Royal townsite, a suburb of Montreal. These houses are at the present time all roofed and well on towards completion and, as a matter of fact, 39 of these have already been sold. Illustrations of a few representative types of the homes being built by this company are shown herewith.

The Britannia Mining & Smelting Company, Ltd., of Brittannia Beach, B. C., built 12 houses this year of the type illustrated herewith. These houses are all of five rooms, the material for the construction being supplied "ready-cut" by the Home Builders' Lumber Co., of Vancouver, B.C. These houses cost $3.000.

Two examples of the types of duplex residences built by the Rockland Housing Co., at Mount Royal, a suburb of Montreal

Two representative types of houses built by Keelefair Construction Company, at Toronto

Ceneral view of the Ioco townsite developed by the Imperial Oil Limited, at Ioco., B.C.

Sketch of a section of Horton & Smith's housing development at Hamilton, Ont.

Three views that indicate the speed with which the Durant Motors plant at Leaside, Ont., was erected. The dates of the photographs are Aug. 21, Oct. 9 and Dec 11, respectively

Three Quarters of a Million Dollars Worth of Buildings in Four Months

The Plant of the Durant Motors of Canada, Ltd., at Leaside, Ont., Was Erected With Remarkable Rapidity—A Group of Buildings of Unusual Interest From a Construction Viewpoint

Three quarters of a million dollars' worth of buildings erected in four months is the record achieved by Norman McLeod, Ltd., general contractors, Toronto, in the construction of the new plant of the Durant Motors of Canada, Ltd., at Leaside, Ont. The speed with which the group of buildings were completed was made possible by efficient organization and by proper direction of all the activities in connection with the construction operations. The necessity for speed was imposed on the contractors by reason of the urgent demand for manufacturing space on the part of the Durant Motors Company, whose business, in the short time that they have been operating, has grown tremendously. When the company established themselves at Leaside, they planned to develop in time an extensive plant, complete in every respect for the manufacture of motor cars, using as a basis an existing manufacturing building, which soon began to prove inadequate. The new buildings which are described in this article serve to round out the facilities already available and make the whole plant another step nearer completion.

When the Durant Motors Co. decided to extend, they gave Norman McLeod, Ltd. the contract, which included the complete designing and detailing of the buildings, the only requirement being that the designs meet with the approval of the owners and conform to the general plan laid down by them. The necessity for rapid construction was emphasized, and to illustrate with what speed the contractors commenced the work, it is worth mentioning that when the contract was awarded, the complete designing and detailing of the group of buildings was finished between Thursday noon and Monday morning.

The job comprised a group of six buildings. Five of these are known as buildings Nos. 6, 7, 8, 9 and 10, respectively, while the sixth building of the group is a cafeteria. In addition to the buildings themselves, the contract included new railway tracks and loading docks.

The cafeteria is a simple building of timber frame construction, with beaver board walls and partitions and stuccoed on the outside. It was re-erected from material which was used in an old building that was already located on the property. The post timbers, wood roof trusses and other members were salvaged and re-arranged in conformity with the design required for the cafeteria. The only unusual feature of its construction was the speed with which it was erected.

Building No. 6 is a single storey structure, 101 ft. 1 in. by 40 ft., connecting the old plant to building No. 7. It comprises light roof trusses carried on exterior wall brackets in the new building and, in the old plant, on beams which were built in over the piers. The building really amounts to only two end walls.

Buildings Nos. 7 and 8 are three storey reinforced concrete structures, 401 ft. 2 in. long, the width of building No. 7 being 101 ft. 2 in. and of building No. 8, 81 ft. 2 in., or one bay less than No. 7. The buildings are divided into bays, measuring 20 ft. in each direction. The No. 7 building has two outside elevator towers which contain the stairs, elevators and toilets for each floor. Building No. 8 has two similar towers, but only one of them is an outside wing. These two buildings are opposite and parallel to one another, between them being located a three track railway siding. Along the track sides of the buildings are reinforced concrete docks, 441 ft. by 48 ft. 10 in.

The buildings Nos. 7 and 8 have no basements, the walls on three sides being carried on reinforced concrete continuous inverted beam footings, while the columns are carried on reinforced individual footings. On the dock sides of these two buildings the walls are not carried on continuous footings, but on individual footings beneath each wall column, spanned by 9 in. by 18 in. concrete beams to carry the walls themselves. The floors are designed according to the flat slab system, the American Concrete Institute's formulae being adopted as the basis of design. The compared loads are 300 lbs. on the first floor, 200 on the second and 150 on the third. Floor thicknesses are: Second floor, 8 in.; third floor, 7½ in. and roof, 6 in. A 1:2:4 mix was used for all of the floors. Interior columns are all circular, those of the first floor being 20 in. in diameter with hoop reinforcement. The second and third floor columns are plain reinforced and are 20 and 18 in. in diameter, respectively. A 1:1:2 mix was adopted for the first and second floor columns and a 1:2:4 mix for the third floor columns. The columns have caps cast in steel forms and also drop heads, the latter measuring 3½ in. deep on the roof and 4¼ in. on the third and second floors. The roof was put on and levelled and the required slope was obtained by means of a cinder fill.

A certain amount of difficulty was experienced with the footings of building No. 7, due to the existence on the site, of footings of an abandoned munition plant. Exact data as to these footings was not available. Where they were uncovered, they were blown out, and excavation carried to the natural soil below.

In a few cases, where disturbed soil was not sufficiently removed, a small amount of settlement occurred in the footings during construction, and in these cases footings in question were shored up and underpinned without damage to the building.

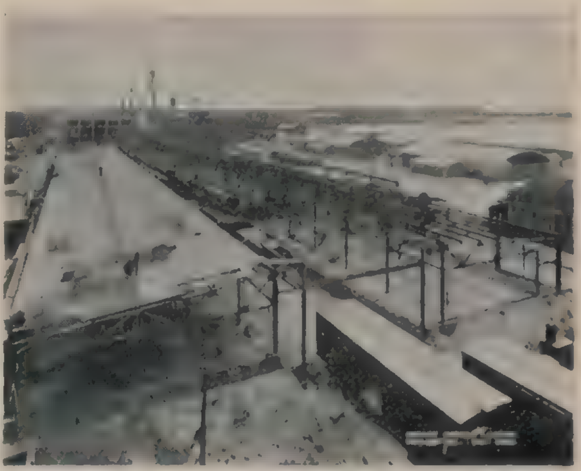
Owing to the possibility of settlement, the ground floor is tarred at all interior columns, so that there will be independent movement between the floor slabs and the columns.

Buildings Nos. 7 and 8 have steel sash on concrete sills with brick panels. The exterior concrete is all rubbed and washed and gives an excellent appearance.

The docks comprise 6 in. concrete slab, extending from the building wall to a retaining wall alongside the railway track. The deck is given a slope of [illegible]-in. to the foot. Behind the retaining walls are inserted drainage ducts and electrical outlets at frequent intervals, so that cords may be inserted for use in cars while loading or unloading.

Building No. 9 is in reality a corridor, 30 ft. wide by 200 ft. long, connecting building No. 7 with building No. 19. It is of light steel frame construction with pilasters of stucco on metal lath.

Building No. 10 is a steel structure, 130 ft. by 501 ft., with a 20 ft. dock along the full length of one side. The framing is light and includes a monitor roof with motor operated sash, 8 ft. deep and divided into four runs of 250 ft. each. Through the centre of the building run two railway tracks. The foundations are similar to those of the buildings previously described while the walls are of brick below the sill line, with pilasters of stucco over metal lath. Steel sash is employed. The roof is of poured gypsum reinforced with mesh. Gypsum board on light T-irons acted as retaining forms during the pouring of the gypsum.



Building No. 10 which is of steel construction with poured gypsum roof

Owing to the necessity for keeping the floor levels of the new and old plants the same, a great deal of fill—20,000 yds.—was required

August 8 October 5 November 28

Progress views of the Durant Motors plant since the ground level was anywhere between 2½ and 4½ ft. below floor level. As many as 180 loads of earth per day were hauled in and compacted by means of a 12-ton road roller and a 5-ton motor truck loaded with sand.

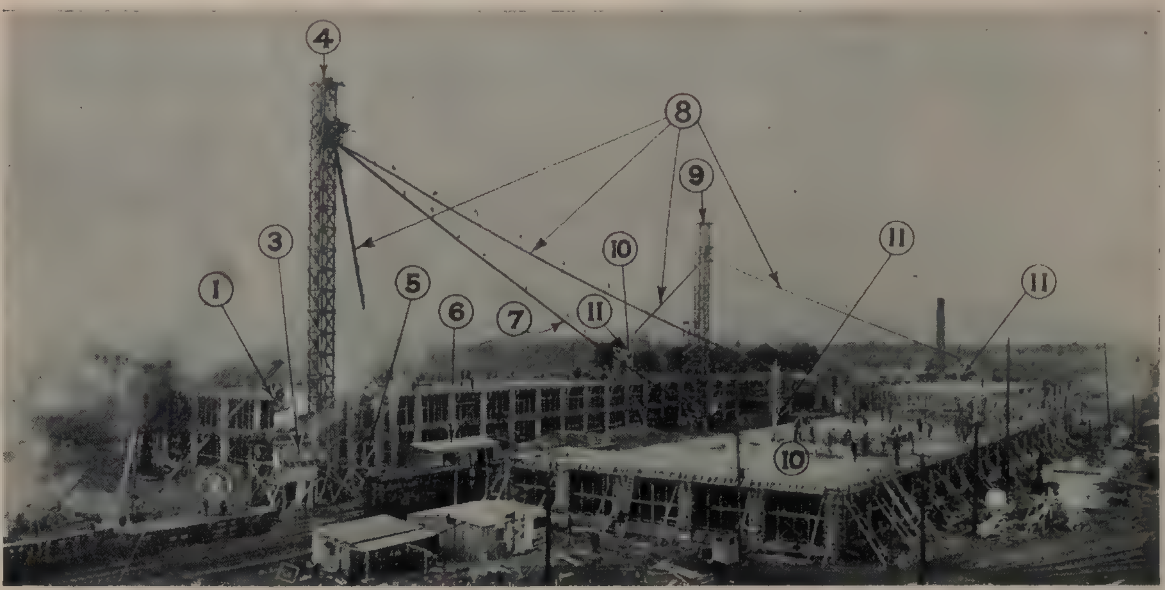
For handling the materials, a ¾-yd. clam was erected adjacent to the railway siding. At night this clam unloaded the cars of sand and stone into storage hoppers over the mixers. Any surplus was placed in a storage pile from which the hoppers were replenished, when necessary. The cement was unloaded into a shed and carried when required by a conveyor belt to the mixer platform. The aggregates were dropped by gravity from the storage bins into the measuring hopper where the cement was added and then dumped into a one-yard mixer which had a capacity of 30 yds. per hour.

The concrete was distributed by means of a main tower 142 ft. high and by a combination relay tower and material hoist, 120 ft. high. A storage hopper at the top of the main tower controlled the supply of concrete to three chutes, two of them running directly to the buildings and the third to the storage hopper on the relay tower, from which a bucket was filled and raised to the top for distribution through other chutes. The concrete was distributed on the building itself by means of buggies. For work below the floor on which work was proceeding, drop chutes were provided, at the bottom of which were gate controlled storage hoppers. The arrangement of this plant, which may be seen from an illustration herewith was most efficient and contributed very materially to the speed with which the job was carried out.

The organization comprised as many as 350 men, but the number varied according to the requirements of the work. At one time, for example, there were 165 carpenters on the job and as occasion arose, the various trades were augmented so that no part of the work would tie up another part.

Some of the quantities involved in the work were:

20,000 bbls. of cement.
12,000 yds. of concrete
300,000 sq. ft of floor finish.
500,000 brick, 300,000 of which were common and the rest face.
65,000 sq. ft. of glass.
450 tons of structural steel.
475 tons of reinforcing steel.
6,500 yds. of sand.
12,000 yds. of stone.
20,000 yds. of fill.
3,000 gals. of Master Builders' Hardener for the floors.



Layout of concrete plant used on the construction of the Durant Motors' plant: 1. 1 yd. clam shell; 2. stock pile; 3. storage bins, measuring hoppers and mixers; 4. main tower, 142 ft. high; 5. conveyor; 6. cement storage; 7. main line to relay tower; 8. distributing chutes; 9. relay tower, 120 ft. high; 10. receiving hoppers; 11. sectional down-spouts.

The following firms supplied materials for the Durant Motors of Canada, Ltd.:

General contractor and designing engineers, Norman McLeod Ltd., Toronto. Steel sash, Peele elevator doors, Canada Metal Window Co., Toronto. Elevators, Otis Fensom Elevator Co., Toronto. Structural steel, McGregor & McIntyre, Toronto. Glass and glazing, Pilkington Bros., Toronto. Interior metal column forms, (Deslauriers), H. A. J. Aldington, Toronto. Electric wiring and fixtures, Canadian Comstock Co., Ltd., Montreal. Heating and plumbing, W. J. McGuire Ltd., Toronto. Fire and kalamein doors, A. B. Ormsby Co., Ltd., Toronto. Roofing, A. W. Carmichael Ltd., Toronto. Plastering, and stucco, W. J. Hynes Ltd., Toronto. Painting, Jos. McCausland & Son, Toronto. Sprinklers, Worcester Fire Extinguisher Co., Toronto. Gypsum, Ontario Gypsum Co., Paris, Ont. Fill, Ontario Construction Co., Toronto. Brick, Toronto Brick Co., Don Valley Brick Works, Cooksville Shale Brick Co. Steel reinforcing, Burlington Steel Co., Steel Co. of Canada, Peck Rolling Mills. Cement, sand and stone, John E. Russell Co., Ltd., Toronto. Rolling steel doors, and floor hardener, John Lindsay, Toronto. Toilet partitions, Roberton-Olsen Ltd., Toronto.

Upstream view of Crawford bridge and control dam, Montreal Waterworks

The Water Supply of Montreal

A Review of the Development of the Montreal Waterworks—The Program Now in Hand and the Methods Used in Carrying it Out

By the Contract Record's Montreal Correspondent

About 65 years ago the city of Montreal constructed an aqueduct or open canal from a point on the St. Lawrence River above the Lachine Rapids to the low level pumping station in Pt. St. Charles at the foot of Atwater Ave. This aqueduct was to perform the dual service of securing an adequate and improved water supply for the city and also providing the means of developing the necessary hydraulic power to pump the water.

The original system, completed in 1856, consisted of a canal 40 ft. wide at the water line, 8 ft. deep and about 4 3/4 miles long; also a terminal structure known as the wheel house which contained the necessary mechanical and electrical equipment for developing power; also the pumps. The waste water from the water wheels discharged into the little River St. Pierre which was immediately behind the wheel house. This small stream was subsequently enlarged and deepened so as to accommodate more easily the flow from the power units. In spite of this deepening and enlarging, the high water in the spring used to back the water up to such an extent that the head on the water wheel was considerably reduced. It was finally decided to instal steam pumps to supplement the pumps in the wheel house operated by the water wheels.

Supply Inadequate

The condition of affairs heretofore described was eventually found to be unsatisfactory and, beginning in 1904, various means were considered for increasing and improving the water supply. These studies and investigations resulted in a start being made in 1907 on what is known as the "First Enlargement" of the aqueduct and this was followed 3 years later by a more ambitious scheme known as the "Second Enlargement." Both projects contemplated the widening and deepening of the aqueduct throughout its entire length and its utilization for supply and also for power. These two projects differed in one essential feature.

The first scheme embodied the idea of sloped sides with stone rip rap at the water level and in this respect was similar to the original canal finished in 1856. The second project contemplated the further widening of the canal and the adoption of a rectangular cross section, the banks being maintained in position by concrete retaining walls.

Before the start was actually made on the first enlargement, a reinforced concrete conduit was built in the north bank of the canal for the purpose of bringing water down to the pumps so that the canal would be completely drained and work carried on in the dry.

It was in December 1913 while work was in progress on the second enlargement that a serious break occurred in the reinforced concrete lateral conduit at a point opposite the Verdun Asylum. The city was without a water supply for 10 days commencing on Christmas day. As a result of this serious accident to the conduit and the subsequent scarcity of water the plans for the aqueduct were again changed. In the meantime an emergency supply was assured in case of accident by tapping into the Lachine Canal, this operation costing the city about $150,000.

Inauguration of Present Project

In 1920, following a complete and thorough investigation by Messrs. R. S. and W. S. Lea, it was decided to follow their recommendations and embark on a new scheme. This latest scheme provides for the best use being made of the work previously done and while intended primarily for using the canal as a water supply incidentally affords an opportunity for developing a limited amount of hydro-electric power if desired. The capacity of the canal being great enough to permit of enough water being diverted to this latter purpose.

In May 1920 a commission was formed to

study the conditions prevailing and to inquire into the practicability of the recommendations advanced by Messrs. R. S. and W. S. Lea. This commission is called the Montreal Water Board and was originally made up of the following gentlemen: Messrs. R. S. and W. S. Lea, Walter J. Francis & Co., and Mr. A. E. Doucet. The Board has been completely changed in the meantime and is now composed as follows: Alderman Brodeur chairman of Executive of the Council, Mr. Terrault and Mr. Fortin of the city's engineering staff. Mr. Desbaillets has been chief engineer in charge of the work since the formation of the original Board.

The duties of this Board were to determine the best available means of guaranteeing an uninterrupted supply of water, as the primary object, utilizing as far as possible the work that had already been done on the aqueduct up to this time.

Synopsis of Work Done Prior to Formation of the Board

The work done under the first and second enlargement schemes was mainly confined to the western or upper section of the canal but at the same time included some work at the lower end of the eastern section near the wheelhouse. Some years before the formation of the Board an imposing structure had been built at the entrance or intake end of the canal. This is known as the Lasalle Bridge and there are 3 large structural steel gates of the Stoney type incorporated in the bridge for regulating the admission of the water from the river into the aqueduct.

Upstream view of La Salle bridge, showing head gates and operating towers

In the Western Section the excavation had been practically completed and reinforced concrete retaining walls of the cantilever type had been constructed on both sides for a distance of 6,900 lineal feet from Lasalle Bridge. Besides this a plain concrete wall of the gravity type had also been built for the remaining distance of 6,000 feet on the north side to the half way point at Crawford Bridge. A certain portion about 2,500 feet long of the cantilever wall on the south bank immediately adjacent to Lasalle Bridge has failed to perform its function. The heavy surcharge on the wall combined with poor foundation material had caused it to move in towards the centre of the canal. This section was no longer serviceable.

In the eastern section a considerable portion of the excavation had been completed in preparation for the construction of the retaining walls following the idea adopted in the "Second Enlargement." The balance of this section was in this condition when work was suspended on the "First Enlargement" begun in 1910. The Church Ave. Bridge had been completed in 1917.

Programme for Completion of the Work

The foregoing paragraphs contain a brief outline of the conditions of affairs when the Water Board took over control in May 1920. Their duties were approximately as follows:

COMPLETION OF THE WESTERN SECTION

(a) Surcharge was removed from the cantilever walls on both sides of the canal where no movement or cracking of the walls had occurred. The earth removed was dumped into the canal at the foot of the walls to provide additional resistance against sliding action caused by weight behind the walls.

(b) Repair of the damaged wall at the upper end of the canal. The method adopted in the repair of this wall was as follows: removal of a portion of the embankment; the formation of an earth fill directly in front of the lower part of the existing wall; the removal of the wall stem down to or below the top of this fill and the completion of the side of the canal above this fill on a 2:1 slope made parallel to the centre line of the canal so as to secure a uniform alignment for the work above the low water level.

Removing the Wall Stem

The removal of the wall stem was accomplished in the following manner. Holes were drilled in the front face of the wall stem on 24 inch centres at a point 6 inches above the top of the earth. The wall was then removed in 50 ft. sections by loading each hole with two-thirds of a stick of dynamite and exploding all charges simultaneously by means of an electric exploder.

The results were evidently satisfactory as the removal sections of the wall fell into the designed position on the slope with very little damage to the concrete. In order to hold these stem sections in place concrete struts were built against the top of the truncated walls and the space between the streets was later filled with rip rap stone.

The saving in rip rap due to the use of these slabs for slope protection was more than sufficient to offset the cost of removing the wall stem.

At the limits of this repair work, transitions were built to effect a gradual change from the 1:5 batter on the face of the retaining wall and the 2:1 slope on the banks.

Constructing the Gravity Wall

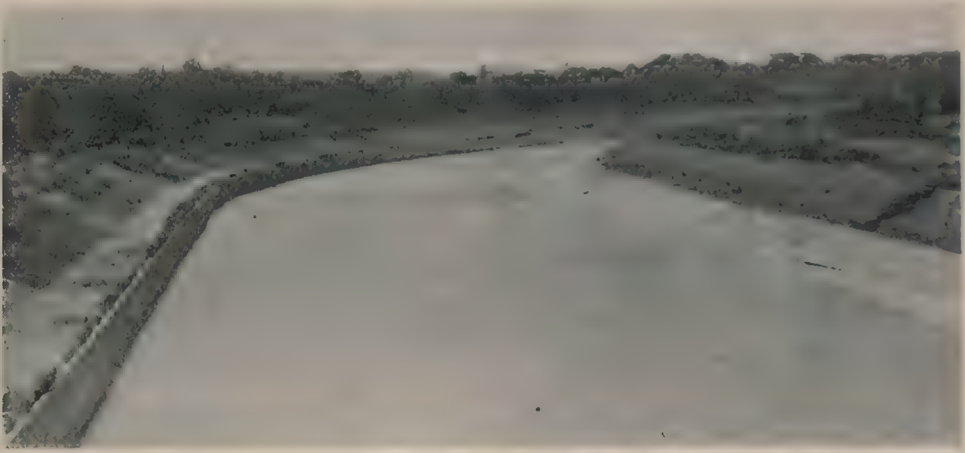
(c) Construction of the gravity wall on the south bank across the rock section for a distance of 6,000 ft. above Crawford Bridge (half way point). This wall on the south side of the rock section is of the plain concrete gravity type and is similar in design and construction to the wall on the north side directly opposite.

On the south side the elevation of the embankment is lower than on the north side so that it was feasible to reduce the height of the wall about 6 feet.

The base of this gravity wall is about 12 feet above the bottom of the canal, built on solid rock, and will be submerged by about 6 feet of water when the canal is at normal level.

Building Bridges

(d) The construction of Crawford Bridge and control dam the object of which was to divide the canal into 2 equal parts, each approximately 2½ miles long, and also permit the maintenance of a controlled water level in the eastern section. Pending the completion of the eastern section, the western section will deliver water at river level to the lateral conduit through the gate chamber immediately upstream from the dam. By this means the present hydraulic losses will be greatly reduced and the capacity of the conduit supply increased about 40%. This increase of 40% was sufficient to take care of the city's requirements for some time to come.



General view of western section from operating tower at La Salle bridge, showing concrete cantilever type retaining wall on left side and sloped type of construction used on the opposite side to replace sections of similar wall damaged.

COMPLETION OF THE EASTERN SECTION

(a) The completion of the Eastern section of the canal, between Crawford Bridge and the wheel house, by the sloping of the sides of the canal and their protection with rip rap at the water line; the formation and grading of the banks; the provision of consolidated fills and concrete core walls to insure water-tightness; the construction of intake to the filtration works and the low level pumping station and also an emergency intake to the new pumping station.

(b) The reconstruction of the wheel house and its utilization as a terminal dam; also the building of a spillway adjacent thereto, for the purpose of regulating the level of the water in the eastern section of the aqueduct.

(c) The construction of 2 permanent reinforced concrete bridges and of the piers and abutments for three future bridges; also the erection of concrete wing walls adjacent to Church Bridge.

(d) The provision of drainage ditches, fences, road and bridge approvals, together with other incidental items of work.

Securing Water Tightness

In the eastern section the ground surface in the vicinity of the aqueduct is generally higher than the proposed regulated water level. As the sub-soil is of boulder clay and practically impervious, special measures to insure water tightness of the banks were only necessary at those places where the original ground level is below what will be the highest level of the water.

In general the method used to insure water-tightness at such places, consists of the construction of a consolidated fill parallel to and beyond the outer slope of the existing bank. In certain other places where good sub-soil was not available as foundation for this consolidated fill concrete core walls were constructed to supplement the fill and insure water-tightness.

In addition to the above, local cut-off walls are provided adjacent to culverts, pipe crossings and other structures built through or in the banks. It was thought that these points might develop signs of weakness.

(Concluded in next issue)

Fifty Millions for Highways

This is the Amount that Has Been Spent in Canada this Year for Road Construction—An Analysis of the Situation by Provinces—The Prospects for 1923

From East to West the question of good roadways has taken on a new complexion. The general use of motors for pleasure and business alike; the introduction of trucks for longer distance transportation; the taste being developed by our rural populations for intercourse with the longer centres and by the dwellers in our towns and cities for a closer communion with nature; the increased cost of transportation by steam; the changed attitude of the farmer resulting from a broader outlook, gained through the exercise of administrative powers in a number of our local legislatures; the influence of our neighbours to the south; all these things have worked together to bring about an attitude of mind where we look upon good motor roads, not only as desirable, but as essentials—at whatever cost is necessary to produce them.

Ontario

A year ago the "Contract Record" predicted that fifty million dollars would be spent on roads during 1922, and this estimate proved very close to the mark. Of this total approximately one half has been spent in Ontario where the Drury Government has proven entirely sympathetic to the demand for better roads. This province's complete programme calls for the completion by the end of 1923 of some 1,850 miles of trunk lines, in addition to county and municipal work which is being undertaken in a generous spirit.

Quebec

The province of Quebec was an enthusiastic pioneer in the development of her highways and is worthily maintaining her record. During the first nine months of the present year the number of miles of improved highways built reached a total of 447. This amount added on to her previous expenditure gives a grand total for the province of 4,345 miles.

Most of the improved highways in the province of Quebec are of the gravel surface type with macadam in second place. Of the total mileage already in use 2,344 miles are gravel and 1,838 macadam. Of the 1922 total of 471 miles, 389 are gravel, 74 macadam, 7 bituminous macadam and 7 concrete.

An ambitious programme has been outlined for 1923 which will probably call for an expenditure in the neighbourhood of ten million dollars. The Department of Roads contemplates the permanent improvement of about 550 miles of main trunk highways and, judging by this year's activity, the municipalities will build about 325 miles.

New Brunswick

During the past year the Province of New Brunswick built 200 miles of improved gravel highway and expect to build another 200 in 1923. Indeed it is the set plan of the province to continue the steady construction of improved gravel roads at this rate for years to come. In addition it is planned to construct 100 miles of bituminous macadam within the next two or three years. Since the year 1917 the province has constructed 12 miles of bituminous macadam highway, 1,000 miles of improved gravel and another 1,000 miles of secondary roads to a lighter gravel standard.

Nova Scotia

Since the present aggressive road-building program was undertaken by the Province of

A typical improved highway in New Brunswick. 200 miles have been built this year.

Nova Scotia the total road mileage constructed or under construction is approximately 4,000 miles and it is the policy of the Highway Board to maintain these roads to the standard of their construction.

During 1922 the Highway Board of this province have either wholly or partly completed 467 miles of road built to the Federal Aid Standard i.e., a high class gravel or waterbound macadam. In addition some 1,300 miles have been improved or are undergoing improvement and nearly 2,000 miles built and maintained to a lower standard.

It is not yet definitely known what the extent of the 1923 program will be but at least 250 miles of gravel road and 20 miles of macadam will be included.

Saskatchewan

The end of the present year will see a total of 700 miles of Provincial Highways completed in Saskatchewan in accord with the Canada Highways Act. During the present year 480 miles will have been built, in addition to taking care of the unfinished work of 1921. The total expenditure has been close to four and a half million dollars made up as follows:

Amount spent by the Government on Main Market Roads	$ 800,000
Expenditure by the Government on the Provincial Highways, 480 miles (and completion of unfinished mileage of 1921)	1,030,000
Amount spent by the Rural Municipalities on Main Market Roads	2,500,000

The total corresponds closely with the expenditure of 1921 and indicates at least the same probable outlay for the coming season, though the matter has not yet been decided by the local government.

Other Provinces

No reliable figures are available for the year's operations in Manitoba, Alberta or British Columbia. Up to April 1, 1922 the province of Manitoba had under way, on the basis of the Federal Government Act, a total of 765 miles. British Columbia, on the same basis, had 217 miles under construction. Since that date the province of Alberta has availed herself of this government aid so that every province of the Dominion is now building trunk roads under this standard agreement.

What of 1923?

So far as the East is concerned the maintenance of a program at least as heavy as 1922 seems assured for 1923. In the Western provinces, where a good crop yield, though it may not remedy unfavorable conditions, will certainly produce a feeling of greater optimism, there should be a decided expansion of the better roads movement. Everything considered, we look to see total expenditures in 1923, on Canada's highways, from ten to twenty-five per cent. greater than during the present year.

Stretch of provincial highway west of **Moose Jaw Sask.** This illustration indicates how the improved highway movement has taken hold in the west.

Reinforced concrete truss bridge in Saskatchewan.

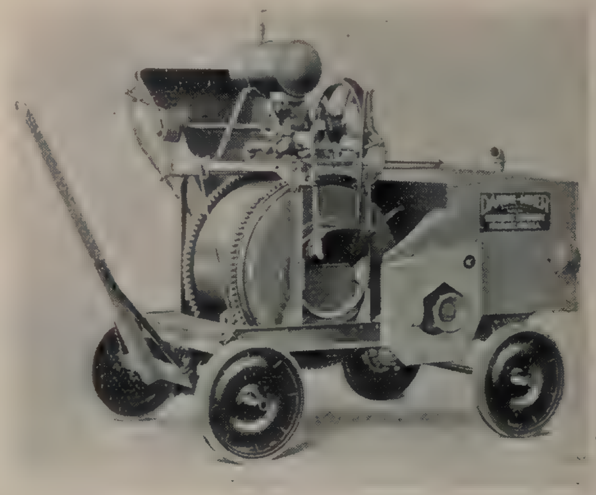
What Is New In Equipment?

The Present-Day Trend is Toward Development and Improvement of Designs that are Considered Fundamentally Sound—Typical Examples of New Machinery

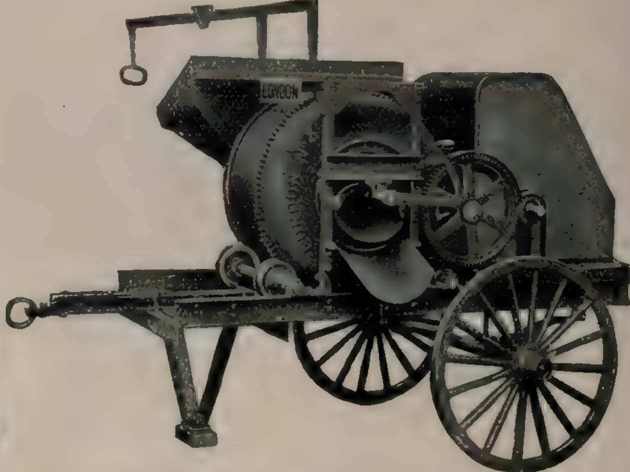
So little of the contracting machinery in common use is still in the experimental stage that it may be said that construction equipment has become pretty well standardized in design. In this respect it is very much akin to the automobile. No longer do we observe those revolutionary changes in design that characterized the motor car in its early days. Rather, do we observe constant and consistent development and improvements of design that are considered fundamentally sound. So it is with construction machinery. Basic designs have been improved in detail until machines to-day are the acme of perfection as far as present knowledge goes. Of course, progress will always be evident and as the requirements of the construction industry are better understood and as they alter to suit changing times and conditions, further development will take place that will make the machinery even more adaptable, more efficient and more essential than ever.

The trend in construction equipment during this year just passing may thus be said to be towards greater refinement. That, of course, means that the machines will be more efficient in the work they perform, more economical in their cost of operation, and more lasting. The equipment manufacturers see quite clearly, that they must make the contractors get the most of their investment and for this reason sturdiness is one of the outstanding features of modern contracting machinery. Contractors can now buy equipment that will give them long service at a minimum of expense for repairs and replacements and that at the same time will perform more work at less money than ever before.

New and improved machines have come out so frequently that it is impossible in the scope of a brief article like this to review every new piece of equipment. What will be attempted, however, is a brief reference to some of the tendencies that have been observed this



An example of the small-sized mixers that are very popular. Built by the Koehring Co., of Canada, Ltd.



Above: A new type of mixer for repair work. Left: A mixer especially built for sidewalk paving. Built by the London Concrete Machinery Co.

year and which are interpreted in this article by some of the leading equipment makers.

Better Concrete is Wanted

The Koehring Co., of Canada, Ltd., for example, state that the constantly increasing traffic coming upon both streets and roads has brought with it an appreciation of the necessity for better concrete. Better concrete means aggregate of proper quality, proper water control, control of time of mixing, a system of placing the concrete on the grade in a manner that will result in uniformity and at the same time reduce the amount of hand labor to a minimum.

Double counterweight chutes for large jobs—Insley Mfg. Co.

The noteworthy trends in the field of construction equipment are further explained as follows:

"Little can be said concerning the size of plant without knowing the character of the work that is being built. The very fact that this company finds sale for paving mixers from 7 cu. ft. capacity to 32 cu. ft. capacity, shows that the owners of paving mixers purchase machines in accordance with the sizes of contracts that they undertake.

Increased Use of Gasoline Driven Mixers

"During the last three years there has been a constant increase in the use of gasoline engines as motive power for construction equipment, until at the present time by far the larger number of paving mixers are equipped with gasoline motors. This does not mean that there is not a definite place for steam power machines but rather that where available gasoline has certain advantages.

"Because of the demand for quality concrete, a water measuring tank has been developed which places the same amount of water in each batch of concrete, but which can be so set as to give the amount of water desired. The time of mixing is controlled by a batch meter. This devise can be described as consisting of a case in which is a series of levers operated by the raising of the skip. A weight is raised through an arc and then allowed to fall. The length of this arc determines the time of fall and as the length of the arc can be controlled, the time of operation can be determined. The charging mechanism on the mixer is locked when the skip comes to the top thereby requiring the operator to hold the material in the drum the full time specified.

"The boom and bucket has proven by far the most successful method of distributing the concrete to place on the grade. By this method the material is spread to approximate thickness without the necessity of rehandling.

"In the construction mixers the development of the past few years has been, in our opinion, toward the use of the seven-foot mixer rather than the three-quarter and yard construction mixer. This does not mean that the larger mixer does not have its place but rather that users are finding the economy of using two small plants on certain projects instead of one large one.

"Small trucks are now used as motive power for drawing mixers around towns and cities. Instead of two to four miles an hour which was the speed when drawn by horse, the mixers now travel at the rate of from fifteen to twenty miles an hour over rough pavements with the result that nuts and bolts shake loose and other difficulties result. To relieve the vibration and shock, rubber tired wheels have been very successfully adopted and are recommended as the best practice for light mixers that are transported for any distances."

Special Mixers for Sidewalk Work

The London Concrete Machinery Co., Ltd., London, Ont., make the following comments regarding recent developments in construction equipment:

"Within the last couple of years, there has been a demand for machinery of an improved type for sidewalk building and also for repair work.

The Insley mast hoist bucket equipment for small jobs

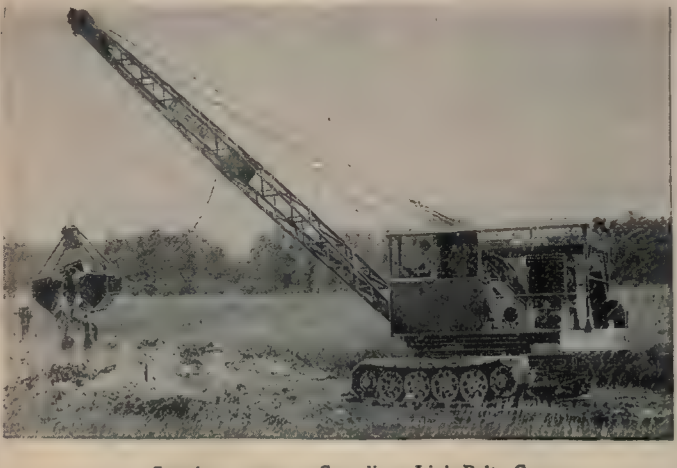
"An illustration on the opposite page illustrates a special sidewalk mixer, which was designed especially for laying sidewalks. With this machine the material may be placed on the streets proper in a long row. The machine is fitted with traction drive and travels along with its own power. The materials are taken from the roadway and placed in the loading hopper on the one side of the machine and the finished concrete is delivered on the opposite side of the machine. A concrete chute is mounted to swing in a half circle, giving a wide radius in which the mixed concrete may be delivered, and while the machine moves along the roadway under its own power, the mixed concrete is delivered to the sidewalk. This special type of machine permits the mixing drum to be mounted very high up on the mixer frame, thus allowing a grade of over 30% to the delivery chute, permitting the concrete to run freely to the point of discharge.

"The city of Ottawa recently put in two of this type of machine, the city of Winnipeg three of them, and several other large contractors have also installed them during the present year.

Machine for Repair Work

"Another cut illustrates a new type of machine for repair work. In most large cities, they set aside an automobile truck for the purpose of carrying material for doing repair. These trucks usually travel at the rate of 15 miles per hour. It is convenient to have a concrete mixer follow the truck, but the ordinary type of concrete mixer with steel wheels will not stand the high speed at which they travel along the road. The concrete mixer, as herein shown is mounted on large wood wheels and automobile springs. The concrete mixer can be attached to the rear of a truck. It will stand travelling over the road at a high rate of speed. It is sufficiently large for repair work.

"The firm manufacturing this outfit also builds the same type of mixer mounted on rubber tires, using the same type of wheel as used on the Ford car, at a small additional cost.

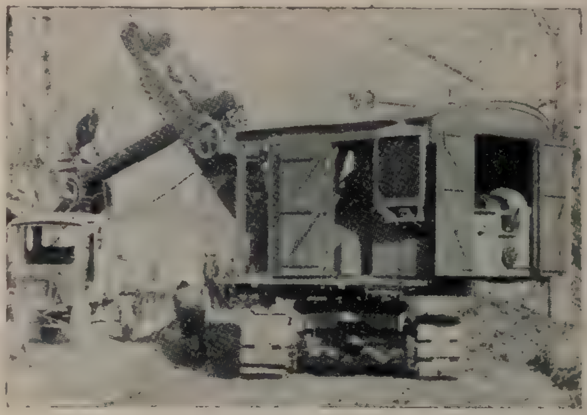


Crawler crane——Canadian Link-Belt Co.

"Among the most recent purchasers of these mixers, we would name the city of Toronto and the city of Windsor. We expect there will be a large field for the use of these machines."

The Insley Manufacturing Company, Indianapolis, Ind., gave their views as follows:

"The comparatively large amount of public work including projects such as reservoirs, bridges, etc. has led to the development of chuting equipment where the actual distribution takes place from a system of double counterweight chutes supported from a derrick or from a cable. The concrete is mixed at a point convenient to the bridging in of materials and then chuted to a mast hopper located on a derrick or to the receiving head of the first counterweight section, depending upon whether the chutes are supported from a derrick or from a cable. A typical installation, the one being used by the DuPont Engineering Company on sewage disposal work at Milwaukee, is shown on the previous page. With the system of double counterweight chutes employed, concrete can be placed at will at any point within the area of a 300' diameter circle; the fact that no ground supports are required for chuting making it very easy to clear reinforcing steel, etc. The illustration referred to shows a development of chuting equipment which because of its freedom of action is bound to receive increasingly widespread attention in connection with works where substantial yardage of concrete are to be distributed over relatively large areas.



Marion gasoline electric shovel marketed by F. H. Hopkins & Co.

Chuting on the Smaller Jobs

"Perhaps the most marked development with reference to chuting falls within the class of the so-called smaller concrete jobs and a cut shows a mast hoist bucket equipment for this purpose. That a plant of this kind involving both a low first cost and low cost of erection is filling a long felt need, is indicated by the reception which is accorded the equipment. For work such as small buildings, short span bridges, retaining walls, silos, etc. it is without an equal.

New Type of Crawler Crane

The Canadian Link-Belt Company, Limited, Toronto, regard the Crawler Crane as one of the most outstanding developments in contracting equipment this year. The design and performance of this crane, which is illustrated in this article, is sufficiently different from other machines of this type to make its introduction an outstanding mechanical achievement this year.

"In general," it is stated, "the crane will safely lift ten tons at a 12 foot radius and 3 tons at a 30 foot radius. The hoisting speed is 125 feet per minute, with a maximum rope pull of 10,000 pounds on a single line. It will rotate four complete revolutions per minute, travel ¾ miles per hour and climb a 20% grade and it is gasoline driven.

"We feel that there is potentially a very large demand for this type of crane, which is more able than previous cranes to cope successfully with all the various working conditions a material-handling machine must meet. The fact that it is gasoline driven makes it a good paying investment in such industrial plants as only handle a small amount of material as no time is lost in starting up or shutting down. On the other hand, the machine will unload ten to fourteen cars in ten hours, which is more than sufficient for most plants. It will travel over ground where even powerful motor trucks will get stuck, so no preparation or expense for trackage is needed. It will operate in the most congested places as the crane will turn in its own length."

Air Tools are Popular

The Canadian Ingersoll-Rand Company, Ltd., Sherbrooke, Que., state: "Undoubtedly the outstanding developments in construction methods and equipment so far as the Ingersoll-Rand organization is concerned is the development, improvement and wider use of portable air compressors, paving breakers, clay diggers, picks, sand rammers, calking tools, drift-bolt drivers, etc.

"We have equipment of this class in use by the Toronto Transportation Commission, city of Guelph, city of Hamilton, Montreal Tramways Co., Nova Scotia Department of Highways, Maritime Telegraph and Telephone Co., Dominion Bridge Co., Canadian National Railways, Canadian Pacific Railway, G. M. Gest, Limited, and numerous general contractors in various parts of Canada.

"The development of the Pneumatic Pick is, we think, particularly worth attention as it is probably the first improvement made in this class of equipment in a good many hundred years and will easily do the work of at least five men using the hand type of tool."

F. H. Hopkins & Co. Ltd., Montreal and Toronto, draw attention to the Marion gasoline electric revolving shovel, which they regard as one of the outstanding developments of the past year or so. Their claims are stated as follows:

"Steam—with its almost universal use, its ease of understanding and its vast and potent possibilities—still maintains the leading position in shovel construction. But no longer does it lay claim to dominance in such industries as have standardized with electric equipment, nor does it seek preference in those localities where coal costs are high or where smoke ordinances are in force, where fire hazards are most carefully considered or where boiler feed water is scarce or unfit for use.

"Successful application of electric and gasoline driven excavators is largely dependent on the selection of proper equipment. For many years builders of this type of machinery have confined their designs to "Single Motor Equipment"—a single engine or motor supplying the power for all the operations of the machine. But we now depart from this practice with distinctly new and original designs. Every operation—hoisting, rotating and crowding—is independent and troublesome frictions and brakes have been eliminated."

Some of the $100,000,000 Worth of Houses Erected This Year

A row of duplex houses erected in Toronto by S. B. Green, builder. Reference to these houses and the one on the right is made in the article beginning on page 1262

A sample of the type of home erected by the Britannia Mining & Smelting Co. Ltd., at Britannia Beach, B.C., for their employees

Descriptions of Some Water Works Pumping Plants

By P. L. EVANS
Goldie & McCulloch Co., Galt, Ont.

Since taking up the manufacture of the Rees Roturbo pump, several years ago, the Goldie & McCulloch Co., who have the manufacturing rights for Canada, have installed a large number in city waterworks in nearly every Province of the Dominion for domestic and fire service, usually driven by an electric motor, but also gasoline driven standby units for service during interruption of the electric supply.

An outline description of a few of the Waterworks in which these pumps have been installed are as follows:—

The city of Windsor, Ont., has two sixteen inch single stage pumps, delivering six million imperial gallons per twenty-four hours against a head of one hundred and seventy-five feet, each direct connected to a 300 h.p., C.G.E. induction motor. At the official test the efficiency of each of these pumps was found to be eighty-two per cent.

At the waterworks of the city of Guelph two pumps were installed in 1920, one pump delivering one million gallons per twenty-four hours against 90 lbs. pressure and the other delivering two million against the same pressure. In 1921 a contract was received for four more pumps for the city of Guelph—two pumps electric-driven, one domestic pump of three million imperial gallons capacity against 90 lbs. pressure and a booster pump of the same capacity against 35 lbs. pressure—the two latter pumps working in series in case of fire, giving a pressure of 125 lbs. The other two pumps are each direct connected to an eight cylinder Sterling engine and are of the single stage type capable of delivering three million gallons per day each against a pressure of 125 lbs. for fire service and may be run at a lower speed to give the same volume against the domestic pressure of 90 lbs. during interruption to the electric supply and consequent shut down of the electric driven pumps.

The city of Stratford was one of the first municipalities in Ontario to adopt this pump. This pump was installed in 1921, and has been doing duty ever since as an electric-driven fire pump, the duty being one and one-half million gallons per twenty-four hours against a pressure of 125 lbs. So pleased was the city with the performance of this pump that in 1919 they purcased another pump of the same capacity and pressure but driven by a six cylinder gasoline engine as a standby unit and this year they have replaced their old domestic pump of another make by a Rees Roturbo pump, which also serves as a fire pump when the standpipe is shut off from the mains. This has a capacity of one and one-half million gallons against 125 lbs. pressure and one million eight hundred thousand gallons per twenty-four hours against 90 lbs., being direct connected to a 125 h.p. Westinghouse induction motor. It may be pointed out that the pump gives the two duties without overloading the motor. This is due to the perfect self-regulating properties of the impeller, and if the pressure should drop to an abnormally low point with a corresponding great increase in volume the power would not increase so as to overload the motor.

Together with this electrically driven pump two more standby units were installed to replace others of smaller capacity. These are each capable of one and one-half million gallons per twenty-four hours against 125 lbs. pressure, direct connected to Sterling six cylinder engines.

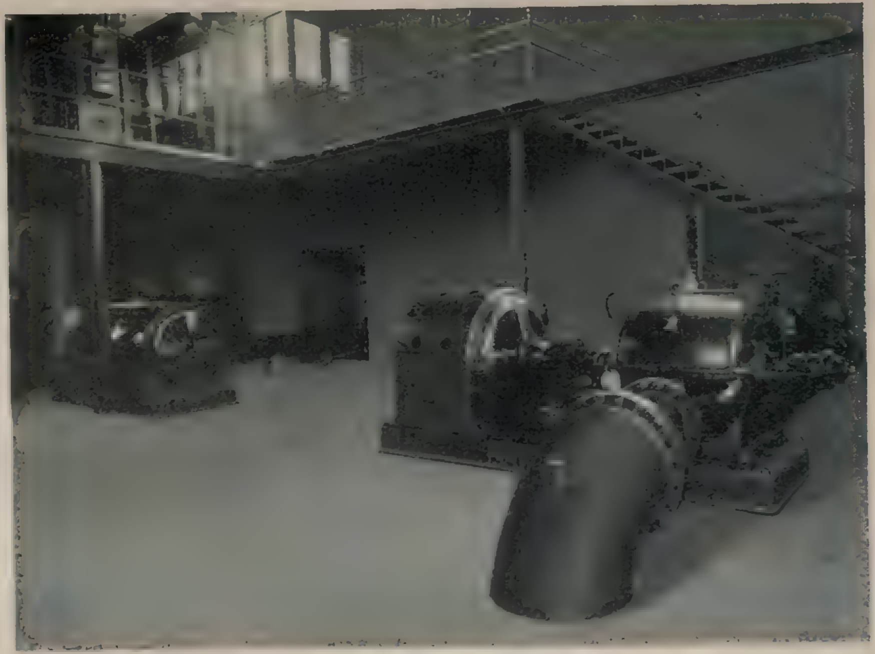
It will be therefore seen that these waterworks are efficiently fitted with pumping equipment of ample capacity and pressure to meet the most extreme requirements they may be called upon to perform for both domestic and fire duty.

This pump is also well adapted for fire service in private installations. A 500 gallon per minute pump of this make has been installed at the Shaughnessy Hospital, Vancouver, for fire service, complete with all fittings such as hose connecting piece, hose valves, relief valve, waste water cone, etc., and conforms to Underwriters' requirements.

Another pump was recently installed and tested at the McTavish Street pumping station, Montreal; this pump serves a large area, including the residential district of Mount Royal. The pumping station is situated at the northern end of McTavish Street and takes water from a reservoir supplied from the main pumping station and delivers into the mains at a pressure of 120 lbs., the pump delivering twelve million gallons per twenty-four hours to the upper levels of Mount Royal. The results of the test showed the overall (or wire to water) efficiency to be seventy-seven per cent when the pump delivered fourteen million gallons, and seventy-six and a half when pumping twelve million gallons. It may be pointed out that this pump is of the single stage double suction diffuser volute type, direct connected to a 925 h.p. Westinghouse slip-ring induction motor, running at a speed of 925 r.p.m.

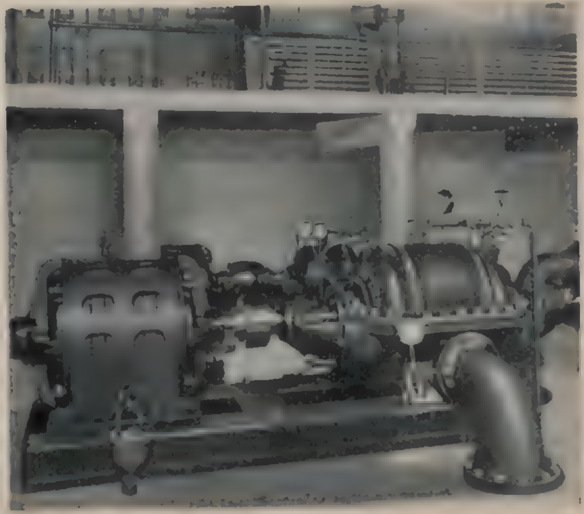
This pump is also being widely used for general industrial purposes, such as boiler feeding, general factory service, condenser circulation, land drainage, irrigation, dock unwatering, pressure pumps for magazine grinders for paper mills and in smaller sizes for sump pumps, etc. It may be mentioned that a single stage volute type, double suction pump has been put on the market, which gives a high efficiency and is simple in construction; being made of the best materials, it is suitable for long continuous service. The regular self-regulating properties are also embodied in the design of this new pump.

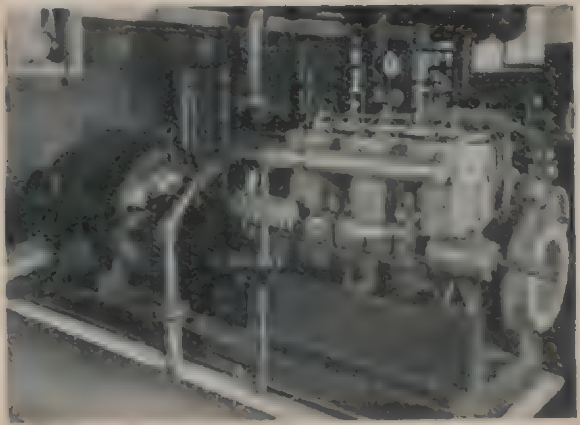
Illustrations of Some of the Waterworks Plants Described on the Previous Page


Windsor, Ont., Waterworks

Cold storage plant of the Montreal Harbor Commission

High level pumping station, Montreal waterworks


Guelph, Ont., Waterworks


Stratford, Ont., Waterworks

CONSTRUCTIONAL ACTIVITY

Period of Dec. 20 to Dec. 26, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Barton Twp., Ont.
Hamilton City & Barton Twp. Councils contemplating watermains. Engr., E. R. Gray; Twp. Clerk, Mr. Bryant, County Court Bldg., Hamilton.

Brantford, Ont.
Brick and plumbing for $18,000 pumping stn. at Brantford not yet purchased. Engr., F. Adams; Clerk, S. F. Leonard.

Burlington, Ont.
Town Council proposes to lay watermains on Princess St. By-law passed. Engr., MacKay & MacKay, Home Bk. Bldg., Hamilton; Clerk, M. Sykes.

Chicoutimi, Que.
Price Bros., 66 St. Pierre St., Que., are erecting a dam and power house at Chicoutimi, Que., to cost about $1,000,000. General Contractor, Wm. J. Bishop, Ltd., 10 Cathcart St., Montreal.

East Hawkesbury Township, Ont.
Township Council has had plans drawn for macadam road. Clerk, N. Labrosse, St. Eugene. Engineers, Patterson & Bryne, 72½ Spark St., Ottawa.

Fort Erie, Ont.
Sewers of Fort Erie and Bridgeburg will be united and a new disposal plant erected, if by-law to be submitted to ratepayers on Jan. 1, 1923 is passed. A. E. Seaton, Town Clerk.

Galt, Ont.
Trunk sewer costing $22,170 being laid by city this winter. Engr., J. D. Black; Clerk, J. McCartney.

Greenfield Park, Que.
Town Council contemplates watermains costing $34,500. Sec., J. Allwright.

$40,000 extension to street contemplated. J. Allwright, engineer.

Sewers costing $78,000 contemplated by Town Council. Sec., J. Allwright.

Hamilton, Ont.
City Council contemplates sewer extensions on Burlington St. and in West End. E. R. Gray, Engr.

Plans are being prepared by the city for a $70,000 extension to sewers. S. H. Kent, Clerk; E. R. Gray, Engr.

Hamilton city council contemplates installation of sewers in Homeside Survey.

Montreal, Que.
City Council contemplates sewer extensions in the northern section of Montreal at a cost of $500,000. R. Bauset, Clerk.

City Council contemplates opening of street. E. Fortin, Engr.

Newport, Que.
Newport & Gascon Town Councils contemplate a road. Engr., Mr. Dufort, Colonization Dept., Que. Prob. general contractor, Art. Richard, Newport, Que.

Ottawa, Ont.
Work will start at once on $15,000 Tarvia macadam pavement. Underground work by day labor. Tenders called for in spring for balance. A. F. Macallum, Commr. of Works.

Tenders will be called for in the spring for balance of work on $11,000 Tarvia macadam pavement. A. F. Macallum, Commr. of Works.

Bell Tel. Co. will start laying conduits in spring. Day labor. Conduits to be bought.

Perce, Que.
Provincial Govt. Dept. of Roads are building a $25,000 roadway. Deputy Minister, J. L. Boulanger, Parliament Bldgs., Quebec. General contractors, Chas. Lamb, Chandler, Que.

Point Grey, B. C.
Sewer extensions costing $57,197 contemplated by C. P. Rly. Local Land Agt., Newton Kerr, Vancouver, B. C.

Price, Que.
Town Council is contemplating an aqueduct. Sec.-treas., Art. Michaud.

CONTRACTS AWARDED

Ottawa, Ont.
National Iron Corporation Ltd., Cherry St. Toronto, have the contract for pipe for watermains in Ottawa. A. F. Macallum, Commr. of Works.

Toronto, Ont.
Construction & Paving Co., Ltd., Confederation Life Bldg. has contract for grading and paving roadway on Nordheimer Estate.

Railroads, Bridges and Wharves

Esquimalt, B. C.
Until Wed. Jan. 31, 1923, tenders will be received by Dom. Govt. Dept. of Works, Sec. R. C. Desrochers, Ottawa, for the installation of pumping and other machinery, in the dry docks.

Grande Riviere, Que.
Town Council contemplates steel bridge 500 ft. long. Engr. Ivan Vallee, Dept. Pub. Works, Quebec.

Normandin, Que.
75 foot steel bridge contemplated by Town Council. Sec.-Treas., J. A. Poivin.

Pemberton, B. C.
Tenders will be received by Provincial Government until Jan. 3, for bridge. Public Works Engr. P. Philip, Dept. Pub. Works, Victoria, B. C.

St. Cajetan D' Armagh, Que.
Town council is contemplating the erection of bridge abutments and will call for tenders in May 1923. Cleophas Boivin, secretary.

St. Edouard, Que.
Work on $6,000 bridge at St. Edouard held up. Will recommence in spring. Work will be of frame construction.

York Twp., Ont.
Competitive plans, sketches, and estimates for the proposed construction of concrete arch bridge, not to exceed $135,000 in cost, will be received by the Twp. Council. W. A. Clarke, Clerk, 40 Jarvis St., Toronto.

Public Buildings, Churches and Schools

Belleville, Ont.
Plans are being prepared for an extension to Albert College. Arch. Chapman, Oxley & Bishop, Harbor Commissioners' Bldg., Toronto. Chairman of Bldg. Committee, W. B. Deacon.

High School Bd. contemplates new bldg. on present iste. Work to go ahead in 1923. Sec. Jeffers Diamond, Dunbar street.

Cayuga, Ont.
Town Council undecided about rebuilding court house and jail destroyed by fire at loss of $20,000. Clerk R. S. Colter.

Galt, Ont.
City Council submitting by-law on Jan. 1 for $10,000 addition to Agricultural Hall. J. McCartney, Clerk.

Greenfield Park, Que.
Town Council is contemplating town hall costing $10,000.

Hamilton, Ont.
City Council contemplates lavatory. Work to proceed in 1923. Clerk, S. H. Kent.

A. W. Holmes, 79 St. Joseph street, Toronto, is preparing plans for $100,000 church in Hamilton.

Normandin, Que.
Church wardens contemplate the erection of a presbytery to cost $6,000 and expect to proceed with the work in June, 1923.

Perce, Que.
Town Council contemplates erection of creamery costing $5,000. Clerk, P. LeBoultillier.

Plantagenet, Ont.
Roman Catholic Church contemplates work on $100,000 church next spring. Architect not appointed. Rev. A. Pelletier, priest, Plantagenet.

Quebec, Que.
Plans are being prepared for a disenfecting bldg. by city architect. J. L.

Pinsonnault. Special machinery will be required.

St. Alphonse, Que.
School Commissioners, Rev. A. Chevallier, president, contemplate building $8,000 model school.

Stoney Point, Ont.
Gilbert J. P. Jacques, Oulette avenue, Windsor, Ont., is preparing plans for $15,000 school for Stoney Point School Board.

CONTRACTS AWARDED

Bagotville, Que.
Noel & Co., Jonquieres, Que., have been awarded the contract for a school costing $75,000 at Bagotville.

Hamilton, Ont.
Thos. Irwin & Son, 22 McNab street have roofing contract for $30,000 church. No tenders for inside work invited for several months.

Lac Bouchette, Que.
Contract for $25,000 church at Lac Bouchette, Que., has been awarded to Eo. Tremblay, St. Anne Co., Chicoutimi, Que.

Montreal, Que.
Dominion Bridge Co., Dominion Station, Lachine, has steel contract for $600,000 Pathological Bldg. being erected by McGill University. Hope Steel Casement Co., Montreal have steel sash contract. and Smith Marble & Construction Co., Montreal, the marble and tile.

E. G. M. Cape has been awarded contract for $80,000 district control bldg.: steel, Phoenix Bridge & Iron Works, 83 Colborne street.; valves and appurtenances, Drummond McCall & Co., Victoria Sq.; pipes and appurtenances, Walsh Plate and Structural Steel Works Ltd., 10 Cathcart St.

Orleans, Ont.
Contract for $110,000 R. C. church has been awarded to J. Burnet.

St. Jerome, Que.
Vulcan Steel & Iron Works, 1698 St. Dennis street Montreal have the contract for ornamental iron, and steel for the $175,000 court-house and jail at St. Jerome, Que.

Business Buildings and Industrial Plants

Alexandria, Ont.
Jos. Laferriere will rebuild hotel destroyed by fire at loss of 10,000.

Alvinston, Ont.
McColl & Co. are having plans prepared for a new flax mill to cost $15,000. Cement block construction. Interested in prices of all materials and equipment.

Bowmanville, Ont.
Foundations in for $100,000 knitting factory for Thomson Kniting Co. Knitting machines and motors to be purchased.

Collingwood, Ont.
Site for $12,000 factory for Canadian Postel Lock Nut & Bolt Co. secured. Value of automatic machinery and plant to be installed $30,000. F. A. Bassett, Collingwood, president.

Cranbrook, B. C.
J. J. Jackson, Cranbrook, B. C. contemplates the erection of store costing $10,000.

Ford City, Ont.
Tenders for htg. and plmg. are being received by Albert Kahn Ltd., architect, Ford, Ont., until Dec. 29 for new $1,500,000 machine shops of the Ford Motor Car Co., Ford City.

Hamilton, Ont.
Harry Goldberg, 72 McNab street contemplates altering an hotel for stores and offices.

Kitchener, B. C.
Nangle Pole & Tie Co. is erecting an office building costing $5,000.

Lac Bouchette, Que.
La Cie Electrique Lac Bouchette, Ltd., contemplates the erection of a $30,000 power house.

Montreal
Work just started on $150,000 express bldg. for C. P. Rly. W. S. D. Cook, contractor, 10 Cathcart street. Undecided what trades he will let. Is buying materials.

Montreal, Que.
Jas. McDuff. 171 St. Dennis street has had plans drawn for additions and alterations to residences into stores and apartments. Tenders called for by owner in January. J. A. S. Houle. 1032 Dorion street architect.

Ottawa, Ont.
Tenders for electric wiring of $6,000 storage bldg. and workshop being built by Suburban Rds. Comsn. are wanted by A. K. Hay, architect Thistle Bldg., Ottawa.

Tenders are still open for plumg. and htg. for bakery being erected by Grocers Bread Co. Ltd. J. P. McLaren, architect.

McAuliffe Davis Lumber Co. contemplates the erection of a shed costing $5,000.

Protection Island, B. C.
Maritime Fisheries Ltd., contemplate $12,000 herring saltery. Capt. B. Jorgensen, Nanaimo. B. C. architect.

Sedgewick, Alta.
Sedgewick Co-Operative Creamery Ass'n is preparing plans for $6,000 creamery. Secy. E. S. Clemes.

Toronto, Ont.
Plans being prepared for mfg. plant for Cocoa Cola Co. Engrs. Harkness, Loudon, and Hertzberg, Confederation Life Bldg. Excavating started. Other tenders may be called for in January.

Mr. Shibley, Dominion Portrait Co., Toronto, contemplates alterations to hotel for apt. house.

Albert Kahn Ltd., Arch. and Engrs., Ford. Ont., will receive bulk tenders (including power plant) for the new assembly plant to be erected by the Ford Motor Car Co. in Toronto. Sub contractors to include in their bids changes in specifications for the following trades: millwork, (int. trim) sheet metal, tin clad doors, orn. iron, metal furring, plstg., glass and glazing, marble and tile, and waterproofing.

Plans are drawn for a new warehouse for Cassidy's Ltd., 51 St. Paul street, Montreal. Architects, MacVicar and Heriot; to be erected on Front street, Toronto. Owners may decide to go ahead next year.

W. A. Robertson. 38 Kalmer avenue, contemplate 7 stores and apts. costing $8,000 each.

Harris Abattoir Co., Ltd., receiving tenders for addition to evaporator house and lard refinery.

Allen and Davies are negotiating for a suitable site on North Yonge street on which to erect stores, with apts. above. Work to start in spring.

Whitby, Ont.
Jeffrey & Son, Port Perry, Harness Makers, contemplate locating in Whitby, in the spring.

Canada Wire Fence Co., contemplates the erection of a $25,000 factory and the installation of $75.000 worth of equipment, if concessions are granted by Town Council.

Winona, Ont.
Growers Cold Storage & Ice Co., Grimsby, contemplate erecting $4,000 ice house in Winona.

CONTRACTS AWARDED

Espanola, Ont.
Heating & plumbing contracts for $30,000 theatre for Stevens Theatres Ltd., awarded to Cutshaw Plumbing & Heating Co., Sudbury. Electrical contract to A. Parent

Kitchener, Ont.
Reitzel Bros., Allen St., Waterloo, have general contract for $10,000 business block in Kitchener. W. H. E. Schmaltz, arch.

Ottawa, Ont.
Dominion Reinforcing Co, Ottawa, have the contract for steel for storage bldg. and work shop being built by Suburban Roads Commission costing $6,000. Plumbing contract awarded to Band & Cole, Bank St., Ottawa.

Montreal, Que.
Richard Ryan, 34 St. Martin St., Montreal, has contract for the $50,000 office & bottling plant of A. T. Stewart Ltd., Montreal. Woodman & Cubbidge, arch.

Ottawa, Ont.
Contracts for branch of Canadian Bank of Commerce, Ottawa, have been let as follows: Tile. National Fireproofing Co. of Canada, Toronto; plastering, C .Hunt, 326 Flora St., Ottawa; marble & tile, Builders Sales Ltd., Sussex St., Ottawa.

J. R. Cameron, 488 Lewis St., Ottawa, ahs the heating contract for the storage & workshop being erected by the Suburban Road Cmsn.

Sydney, N. S.
C. W. Totten has the excavating contract for $350,000 hotel at Sydney, N. S. A. J. McCormack, arch.

Three Rivers, Que.
McLennan Lumber Co., 21 Dorchester St., Montreal, have the lumber contract for addition to bleachery being made at cost of $40,000.

Toronto, Ont.
Salisbury Electric Co., 112 King St. W., Toronto, has been awarded the

Tenders and Proposals

Official Notices by Governments, Municipalities, Architects and Engineers

Notice to Contractors

Sealed tenders marked "Tender for Contract No. 963" will be received by the undersigned until 12 o'clock noon, **Thursday, January 18th., 1923**, for the erection and placing of a crib around one of the Piers of the Provincial Highway Bridge south of Belleville across the Bay of Quinte.

Further information, plans, specifications, and tender forms may be obtained on and after Wednesday, January 3rd., 1923, at the office of the undersigned and at the office of W. Noonan, Resident Engineer, Napanee.

A marked cheque for $500.00 payable to the Minister of Public Works and Highways, Ontario, or a Guaranty Company's bid bond for a similar amount must be attached to each tender. A Guaranty Company's Contract Bond for 50 per cent. of the amount of the tender will be furnished by contractor when contract is signed. All bonds must be made out on Departmental forms.

The lowest or any tender is not necessarily accepted.

W. A. McLEAN,
Deputy Minister of Highways.
Department of Public Highways, Ontario,
Toronto, December 22nd., 1922. 52

Scarboro Public Utility Commission

Water Area No. 2

Tenders For Laying Watermain

Tenders properly marked and sealed, addressed to Mr. W. D. Annis, Secretary of the Commission will be received up to 5 p.m., **Monday, January 15th., 1923**, for the labor involved in laying approximately the following quantity of watermain:-

5500 feet of 12"
12000 feet of 8"
14000 feet of 6"

It is the intention of the Commission to prosecute this work throughout the winter.

Plans, specifications and all details may be obtained at the office of the Engineers or Commission.

JAMES PROCTOR & REDFERN, LTD.,
Consulting Engineers,
36 Toronto St.,
Toronto.
R. M. CROKER,
Reeve & Chairman.
W. D. ANNIS,
52-1 Sec'y., Birchcliffe, Ont.

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The equipment or machinery that you are not using.

It may be occupying valuable space in your yard or shop, collecting dust, rust and hard knocks.

Sell it before "Depreciation" scraps it.

Use the Tender & For Sale Department. It helps others, let it help you.

RATES

20 cents per agate line (14 lines to the inch) Positions Wanted 1 cent per word per insertion. Positions Vacant 2 cents per word per insertion. Box number 10 cents extra. Advertisements for this Section must be received not later than noon on Tuesday to ensure insertion in Wednesday issue.

FOR SALE

One land dredge about 1 yd. dipper, kerosene engine can be converted into float by mounting on scow. Address Box 318, Walkerville, Ontario. 50-52

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Lengths 10 ft. to 40 ft. with corners, y's, t's and wedge pieces.

Universal Equipment Co.

Niagara Falls, Ontario

Phone 329, Office at Upper Steel Arch Bridge. 42-T.f.

Civil and Electrical Engineer

Applications will be received by undersigned up to January 15th, 1923, for positions of Civil and Electrical Engineer, separate or combined, for city of Prince Rupert, B. C. Duties to commence February 2nd, 1923. State qualifications and salary required and give references.

Combined duties will include superintendence of light, telephone, and water systems, and also those of City Engineer.

ERNEST A. WOODS,
52 City Clerk.

Book-Keeper:—Wanted a competent man who has had experience in railroad construction accounting. Apply to box 63, Contract Record, Toronto. 52

To contractors or municipalities and executives: —Wanted—position as superintendent or foreman, by married man; 30 years' practical experience mining, mechanical and construction engineering, tunnel, roads and bridges, installing, moving and repairing machinery; have handled men and material in many parts of the world; A1 mechanic; willing to go anywhere or do anything. F. J. M. Blackham, 285 North Cumberland Street, Port Arthur, Ontario. 47-2

Want Hudson Bay Railway

Passing of a resolution calling upon the Dominion Government to complete as soon as possible the construction of the Hudson Bay Railway was the main item of business transacted by the Saskatchewan Associated Boards of Trade meeting at Regina.

Shortage of Apprentices

"There is too much education to fit boys for white collar jobs and not enough boys being apprenticed to the building and other trades to fill the places of the mechanics who are dying off."

This statement by building contractors in this city summarized their views on the apprentice question. A report on the question will be submitted to the Ontario convention of the Association of Canadian Building and Construction Association, and included in it are proposals which, if adopted, will, they think, solve the problem and make the building trades attractive to young men. In brief, the proposed remedy is to start a fund for which a levy would be made on the contractors and Government, and from this pay for the vocational training of apprentices during the off-season. The building trades are in danger of becoming lost arts and it is vitally necessary to provide some means of making them attractive to youths. They believe the fund suggested would bring about this result and say it could be raised and administered as is the Workmen's Compensation Act fund, a levy being made on all contractors.

Week's Fire Loss

Fire losses in Canada during the week ended December 13 are estimated at $1,027,850, compared with $2,827,500 the previous week.

Uruguay's Railway Systems

Although the railway mileage in Uruguay is usually given in round number at approximately 1,650 miles, the actual total is given at 2,597 kilometers (1,613 miles). The entire system is of standard gauge. Of the private railways, 991 miles are operated with State guaranty, while the remaining 501 miles of privately owned railways are operated at State railways. There are 121 miles of railroad operated as State railway of which a small branch line 2 miles in length is rented from a private railway.

The gross revenue for all Uruguayan railways amounted to 10,256,661 pesos in the fiscal year 1920-21 as compared with 10 559,470 pesos in the preceding year. The net earnings amounted to 1,892,045 pesos during the fiscal year 1920-21, compared with 3,289,695 pesos during the year 1919-20. The decrease of 1,397,650 pesos in amount of net earnings in the fiscal year 1920-21 is almost entirely the result of increased expenses during the year. Work was begun in October, 1921, on the construction of the new State railroad from San Carlos to Rocha, a distance of some 45 miles. A Uruguayan firm contracted to build this road for the account of the Government for 2,175.000 pesos ($2,248,950).

contract for electric wiring of $20,000 residence. W. W. Pettley & Co., general contractor. Painting to be let.

Structural steel contracts for alterations to Holden Bldg., 342 Adelaide St., Toronto, Dominion Bridge Co., Toronto; electrical, Canada Electric Co., King St. E.

Toronto, Ont.

W. J. Hynes, Ltd., 858 Dupont St., has the plastering contract for $350,000 office bldg. on Bay St.

Residences

Bowmanville, Ont.

Wm. Quinn is building a $5,000 residence. general contractors A. L. Quinn.

East Toronto, Ont.

P. Balderson, 129 Sphuce Hill Road, contemplates the erection of six pr. residences. Work to start early in spring.

Hamilton, Ont.

Taylor & Griffin have commenced work on two residences costing $7,500.

Duro Construction, 1 Main St. E., is having plans prepared for three brick residences to cost $24,000.

Plans are being prepared for $8,000 residence. Lowry & Black, Spectator Bldg., owners. Duro Construction Co., Main Street E. general contractors.

Hutton & Souter, Bank of Hamilton Bldg. are pereparing .plans for $10,000 residence near Hamilton.

F. A. Maude, 97 Rosslyn Ave. is having plans prepared for 3 residences costing $15,000.

Montreal, Que.

J. R. Duquette, 157 Monk Blvd. contemplates 3 residences costing $20,000.

Foundations going in for $10,000 residence for Chas. Russell, 1746 James Street, J. A. Perrault, contractor, 125 Adam street, will let sub-trades. Buying material.

W. Hanfield, 11 Place D'Armes, contemplates $60,000 apartment house. Arch. A. Chausse, 7 Notre Dame street W.

H. Glenney, 351 Fabre street, contemplates the erection of a residence next spring.

A. Hogue, 1247 Henri Julien Ave., is erecting two residences at cost of $16,000.

Two residences are being erected by J. & S. Besner, 340 Christophe Colombe street at cost of $18,000.

E. Pepin, 352 Garnier street, is erecting a residence at cost of $10,000.

Tenders are being received by the Corp. des Logements Ouvriers, Ltd., 195 St. Catherine street E., for Rfg., Elec., Plmg., Plstg., & Brickwork on 200 residences being erected at cost of $700,000. Millwork to be let shortly. R. Charbonneau, arch.

Bigonesse & Bigonesse, architects, 182 St. Catharine street, have almost completed plans for 24 suites of apartments. Tenders will be called for about Jan. 15, 1923.

Montreal West, Que.

Residences costing $12,000 being built by A. M. McPhee. General contractors, Thos. Gray, 976 Tupper street.

St. Famile, Que.

Andre Morency contemplates erection of two residences costing $3,000 each.

Sarnia, Ont.

Watt & Blackwell, Bank of Toronto Bldg., London, are preparing plans for $15,000 residence for Dr. F. N. Sangster, Sarnia. Tenders will be called for by owner.

Toronto, Ont.

J. E. Carlisle, 195 Pinewood Ave. contemplates 2 residences on Forest Hill Rd.

W. N. McEarchin & Son, 1801 Danforth Ave., contemplates the erection of 12 residences.

George Milverton, 318 Milverton Blvd. contemplates the erection of 5 residences costing $4,000 each.

Foundation are going in for two residences being erected by A. A. Hassard, 73 Harris avenue, at cost of $9,000.

A. J. Henderson, Humewood avenue, excavating for $15,000 Duplex residence

M. D. Beard, 50 Front street, contemplates the erection of Duplex dwelling on Montclair avenue.

York Wrecking Co., owner and general contractors is receiving tenders on painting, plastering, plumbing, heating and wiring, for $15,000 Duplex residence on Northcliffe blvd.

New tenders to be called for 3 6-family apts. being built by Jno. Henderson, 666 St. Clair avenue costing $25,000. Work to be held over until spring.

A. Groat, 61 Lawton Blvd., is erecting 2 residences costing $7,000 each.

P. R. Langman, 52 Stephenson avenue, is erecting 2 pairs of residences at cost of $6,000 each. Electric, plumbing, heating, plastering and painting contracts to be let by owner. Roofing, furnace, int. trim, flooring and hardware, not purchased.

Fred Allen, 805 Shaw street, has commenced work on brick residences in North Toronto. Contracts to be let for plstg., ptg., htg., elec., and plmg. Hardware not yet purchased.

Wm. J. White has purchased the sites and contemplates the erection of 52 residences, commencing about Mar. 1. 1923.

CONTRACTS AWARDED

Montreal, Que.

Contracts for sash and doors for residence and garage costing $25,000 have been awarded Benoit & Mathieu, 195 Timothee street, Montreal. Tile contracts to E. Le Page 990 Parthenais St.

L. P. Ducharme & Co., 2056 James street have the roofing contract for 4 residences costing $32,000. Plumbing & heating contracts let to Leggett & Owen, 4128 St. Catherine street W.

Hickey & Abut, 93 Dominion street, have the roofing contract for $9,000 residence being built by F. K. Brydges.

Ottawa, Ont.

Heating contracts for 3 residences costing $14,000 have been awarded to the Capital Hdwe. Co., Bank & 5th Ave.

Outremont, Que.

Viens & Co., have the general contract for a $15,000 house and garage, for C. A. Reeves. Tenders wanted on all sub-trades. No materials purchased.

Roofing contract for pair semi-detached residences costing $30,000 has been awarded Dominion Sheet Metal Works, 294 Laval avenue; electrical, Geo. Shearington, Park avenue. Extn.; millwork, W. H. White, Ville St. Pierre; plastering, A. Menard; painting, L. P. Caron

Toronto, Ont.

A. H. Badger, 534 Yonge street, has contract for interior trim for $20,000 residence being built by Grimshaw Bros.

West Vancouver, B. C.

R. P. Jaggard has heating & plumbing contract for residence being built by H. A. Hadgson, Vancouver.

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Power Plants Electricity and Telephones

Drummondville, Que.

Plans are being prepared and tenders will probably be called for in spring for work on new plant contemplated by Southern Canada Power Co., Ltd. J. S. Wurtell, Engr.

Richmond, Que.

Southern Canada Power Co. Ltd., contemplates transmission line from Richmond to Drummondville costing $104,000. Engr., J. S. Wurtell.

Rockland, Ont.

Rockland Electric Power System is commencing work on $25,000 electric plant. Supt. A. C. Marion. Eletric fixtures & machinery will be needed. Owner in market for generators, motors, trahsformers, boilers, converters, switchboards, copper wire and galvanized wire.

Sheet Harbor, N. S.

Tenders being received until Jan. 2 by Nova Scotia Power Commission for transmission line from Malay Falls to Hopewell. Sec. A. T. Croft, Metropole Bldg., Halifax, N. S.

Winnipeg, Man.

Tenders will be received by City Clerk C. J. Brown, for power plant machinery until Jan, 23, 1923.

Miscellaneous

Hamilton, Ont.

City Council contemplates spending $25,000 onthe development of a bathing beach. Engr. E. R. Gray. Clerk, S. H. Kent.

City Council contemplates building Public Swimming Pool costing $20,000 Engr. E. R. Gray.

St. Andrew's Benevolent Society contemplates the erection of a hall. Site purchased at cost of $12,000.

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W. R. Kirkpatrick
Canadian Secretary

UNITED STATES FIDELITY & GUARANTY COMPANY

St. Hughes, Que.

Town Council contemplates gravelling 10 acres. In market for sand. Sec.-Treas. W. Melacon.

Toronto, Ont.

Tenders being received until Jan. 4, for repairs to dredge. May be seen in Toronto Harbor. Dom. Gov't. Dept. Pub. Works, Ottawa. Sec. R. C. Desrochers, Parliament Bldgs., Ottawa.

CONTRACTS AWARDED

Dickie Construction Co., Ltd., Toronto have been awarded the general contract for $18,000 addition to Victoria Skating Club. Molesworth, West & Secord, architects.

Fires

Mission City, B. C.

Hotel destroyed by fire at loss of $10,000. R. W. Bryant, owner, will probably rebuild soon.

London, Ont.

Fire destroyed furniture storehouse of Alex. Henderson, 432 English street. Loss $9,000, owner not yet decided to rebuild.

Hazenmore, Sask.

Pioneer Grain Co. Ltd., elevator destroyed by fire. Loss $8,500, owners will rebuild shortly.

Alabama Passes Improvement Bonds

In the U. S. general election, two constitutional amendments were passed by the State of Alabama by large majorities, which make available considerable funds for public works construction. The first amendment authorized the state to lend its credit to the State Dock and Harbor Board to the amount of $10,000,000 for the construction of docks in Mobile Bay The work will proceed along the lines followed by Louisiana in work at New Orleans. A meeting of the Dock and Harbor Board has already been held for the purpose of outlining a construction program.

Another amendment to the constitution allows twelve small cities of the state to issue water-works bonds in excess of the present debt limit.

Huge Irrigation for South Africa

The biggest irrigation works in South Africa, and second only in the whole of Africa to the Assuan Dam on the Nile, has just been completed. The works are known as the Lake Mentz Conservation Works, and are located in the Sundays River valley near Port Elizabeth. The union government financed the undertaking to the extent of £500,000 in the interest of land settlement and to further development of the agricultural resources of the union. The dam impounds 25,700,000,000 gallons of water and the area submerged is 4,900 acres. Subsidiary works lower down the Sundays river construted by private enterprise at a cost of £600,000 consist of three diversion weirs and canals extended over 400 miles. The scheme aims at intensive cultivation under a permanent water supply of an area over 40,000 acres

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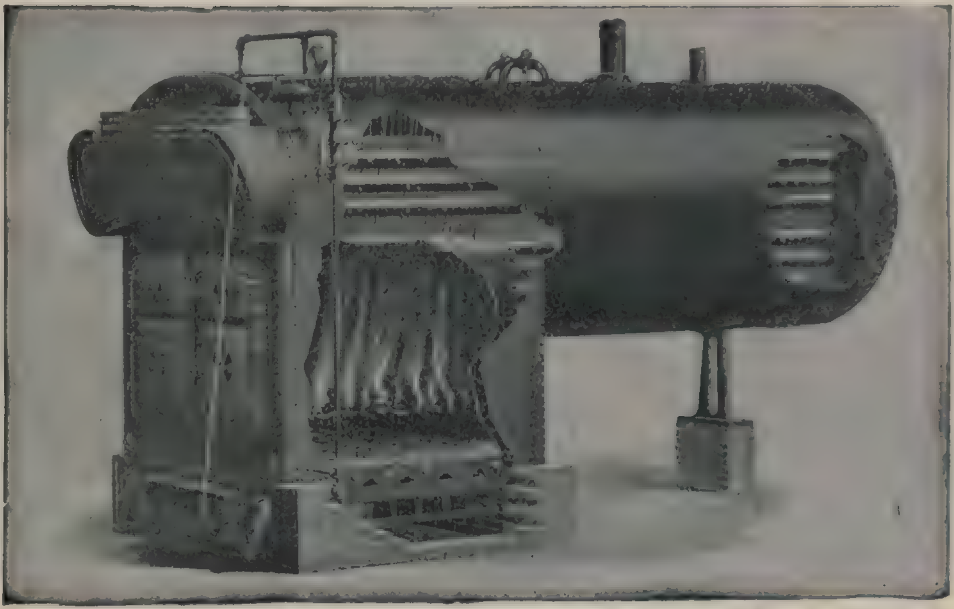

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Moscow in Throes of Building Boom

Moscow to-day is passing through a building boom more active than anything of the kind the white-walled city has experienced in several generations.

Real estate improvement has been virtually at a standstill since early in the world war, and after the revolution, which eventually brought the seat of government back to the ancient capital, Moscow became one of the most crowded cities on the face of the earth.

This fall, however, under the Soviet's new economic policy, which permits private enterprise, including leases on property and buildings for 49 years, the rush to gain concessions by local investors began, with German, French and other foreigners also clamoring for privileges. The Government itself also has improved many buildings.

Hundreds of business houses, as well as fine old homes, were so badly damaged during the revolution that it was necessary to rebuild them. Walls of scores of other buildings, ruined by fire, are still standing in various parts of the city, but provision has been made for remodeling most of these next spring.

Store space is in great demand, due to the stimulus given by the resumption of free trade, and numerous one-storey affairs have been put up in the shopping districts. They resemble the stores erected in a boom town in Canada or the U.S. Small wooden shacks for the retail selling of books, fruit, clothing and various necessities, have been built temporarily here and there throughout the city, but these will be pushed aside with the resumption of trade through the ordinary channels.

Entire blocks have been cleared for apartment houses, with shop space on the ground floor, and thousands of men and women—usually more women than men—have been employed in this work, carried on with great speed to get as much done as possible before the cold weather begins, when all outdoor tasks of this kind must cease until spring.

There is scarcely a block in Moscow these days upon which some repair work has not been done, or a new building of some sort erected.

To Electrify 30-Mile Section of Vera Crux-Mexico Railway

Contract for the electrification of 30 miles of track on the Mexican Ry. Co Ltd., between Orizaba and Esperanza on the main line from Mexico City to Vera Crux has been announced by the International General Electric Co. The project calls for the expenditure of between $2,000,000 and $2,500,000 and will be financed through London.

The system will be operated by 3,000-volt direct current which will be supplied by the Pueblo Tramway, Light and Power Co. from hydro-electric plant about five miles from Orizaba. The present contract includes ten 150-ton locomotives, equipment for one sub-station, overhead conductors and accessories. The ruling grade on the electrified section will be 4.7 per cent

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To Unify Railways

The Free State government has decided on the unification of Irish railways in either one or two groups. Legislation with this object in view will be introduced in parliament within the next six months.

·BULLETIN·№ 5·

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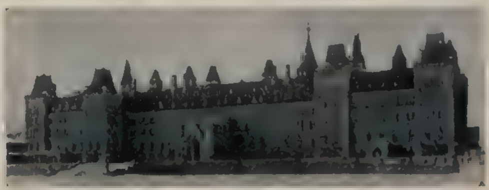
IF YOU BEND A RAIL-CARBON BAR WITH A JERK IT IS LIABLE TO BREAK, BUT NEITHER DOES THIS CONDEMN THE BAR.

THE ELASTIC LIMIT OF A MILD STEEL BAR IS AROUND 33,000 lbs. per sq. inch. THE ELASTIC LIMIT OF A RAIL-CARBON BAR IS WELL OVER 50,000 lbs. per sq. inch OR AN INCREASE OF 50%.

SOME ENGINEERS WILL TELL YOU THEY HAVE SEEN RAIL-CARBON BARS ACCIDENTLY DROPPED AND BROKEN IN TWO



DOMINION PARLIAMENT BUILDING OTTAWA
RAIL CARBON STEEL BARS USED FOR REINFORCING CONCRETE

DID YOU EVER CONSIDER WHAT WOULD HAPPEN TO A MILD STEEL BAR IF DROPPED UNDER SIMILAR CONDITIONS?

THE BLOW WHICH BREAKS THE RAIL-CARBON BAR WOULD STRESS THE MILD STEEL BAR AWAY BEYOND ITS ELASTIC LIMIT, THE METAL WOULD BE PERMANENTLY STRAINED BUT YOU DON'T KNOW IT AND YOUR INSPECTOR CAN'T FIND IT OUT.

BENDING IN THE FIELD IS MOST COMMONLY DONE BY UNSKILLED LABOR.

UNSKILLED LABOR RARELY REALIZES THAT ANY AND EVERY BAR MUST BE BENT AROUND THE MANDRIL SLOWLY IN ORDER TO ALLOW THE METAL TO "FLOW."

THE WORD YANK IS NOT DEFINED IN WEBSTER'S DICTIONARY BUT IT MIGHT VERY TRULY BE DEFINED AS "THE PREVAILING METHOD, EMPLOYED BY UNSKILLED LABOR IN BENDING REINFORCING BARS."

UNDER THE "YANK" METHOD, THE MILD STEEL BAR IS PERMANENTLY STRAINED AND IS SO EMBODIED IN THE STRUCTURE,— THE HOOK AT THE END OF YOUR RODS IS RENDERED USELESS.

UNDER THE "YANK" METHOD THE RAIL-CARBON BAR BREAKS AND IS THROWN OUT,—AND YOUR CONTRACTOR SOON SEES TO IT THAT THE "YANKING" STOPS.

WHICH DO YOU PREFER:

AUTOMATIC PROTECTION OR CONCEALED DEFECTS?

WE HAVE EVERY MODERN FACILITY AT OUR PLANT FOR BENDING TO YOUR SCHEDULE AND PREFER TO SHIP THE BARS TO YOU CUT TO LENGTH, TAGGED AND BENT READY TO DROP INTO THE FORMS.

WE PRIDE OURSELVES ON FAST AND ACCURATE DELIVERIES.

WHY NOT TRY US OUT?

·BULLETIN·№ 6 - THE ·SPECIFICATION·

Current Prices of Building and Engineering Materials

		Toronto	Montreal	Winnipeg	Vancouver
CEMENT (Delivered on job):—					
Retail lots including bags	per bbl.	$4.60	$4.40	$4.80	$3.70
Car lots, including bags	per bbl.	3.85	3.68	4.16	3.35
Refund on bags	each	.20	.20	.20	
LIME (Delivered on job):—					
Lump, in retail lots	per ton	14.30	14.00	.58 bu.	2.70 bbl
Lump, in car lots	per ton	12.70**	11.00	13.80 ton*	2.60 bbl
Hydrated, in retail lots	per ton	20.00	26.00	.60 bag*	30.00
Hydrated, in car lots	per ton	19.00	21.00	.54 bag*†	25.00
BRICK and TILE (Delivered on job):—					
Common face brick	per M.	24.00	16.00*	19.00	30.00
No. 1 dry pressed brick	per M.	31.00	30.00	36.00	70.00
No. 2 dry pressed brick	per M.	29.00	25.00	32.00	
Enamelled brick	per M.	125 up to	230.00	185.00	150.00
Wire cut brick, for foundation work	per M.	21.00	19.00		50.00
Sand lime brick	per M.	17.00		18.00	
Hollow building tile	per M.			8-12c. per ft.	105-240,00
Paving brick imported	per M.	on appl.	100.00	55.00	60.00
Fire brick	per M.	60-95	60-75	85-100	80.00
Fire clay	per ton	13-20	15-16.00	35.00**	22.00
STONE, SAND and GRAVEL (f.o.b. cars on siding):—					
Crushed stone, 2 in.	per ton	2.05**	1.80	2.45 yd.*	$2.00 yd.
Crushed stone, 1 in. and under	per ton	2.31	1.90	2.75 "	" "
Crusher run	per ton	2.20½		3.00 "	" "
Rubble stone	per ton	2.45	1.70	15.00 cord	" "
Gravel, 2 in. screened	per ton	2.05		2.45 yd.	" "
Gravel 1 in. screened	per ton	2.31	1.50	2.75 "	" "
Sand, screened	per ton	1.42½	1.25	1.90 "	" "
Pit run	per ton	1.52¾	1.25	1.90 "	" "
STEEL and IRON (f.o.b. warehouse):—					
Mild steel bars, ¼ in. and heavier	per 100 lbs.	3.25 base	3.25 base	4.35	$4.00
Bands 3/16 in. and lighter	per 100 lbs.	3.75 "	3.25 "	4.85 base	
Hoops	per 100 lbs.	4.50 "	4.25 "		
Twisted and deformed bars	per 100 lbs.	3.35 "	3.25 "	4.20	4.00
Angles, channels and tees under 3 in.	per 100 lbs.	3.35 "	3.75 "	4.95	6.00
Structural shapes	per 100 lbs.	3.60 net	3.75 "	4.75	6.00
Plates—¼ in. and heavier	per 100 lbs.	3.25 base	3.50 "	4.75	6.25
Plates—3/16 in.	per 100 lbs.	3.60 "	3.85 "	5.15	6.50
Plates—10 gauge	per 100 lbs.	4.15 "	4.00 "	5.45	6.50
Black sheets—28 gauge	per 100 lbs.	5.10 "	4.50 "	6.50	8.25
Galvanized sheets—28 gauge	per 100 lbs.	6.20 "	6.00 "	7.85	9.35
Galvanized Corrugated sheets—28 gauge	per 100 ft.	6.20 "	6.50 "	7.70	8.25-8.50
Rivets	per 100 lbs.	5.75 base	5.50 base	7.00 base	
Cast iron pipe	per ton	60.00	55.00		
VITRIFIED CLAY PRODUCTS (Delivered on job):—					
Sewer pipe, 4 in.	per ft.	.40	.30	.35	.28
Sewer pipe, 6 in	per ft.	.60	.45	.45	.48
Sewer pipe, 8 in.	per ft.	.80	.70	.60	.55
Sewer pipe, 9 in.	per ft.	1.00	.85	.70	.60
Sewer pipe, 10 in.	per ft.	1.20	1.05	.80	.70
Sewer pipe, 12 in.	per ft.	1.50	1.35	1.00	.85
Sewer pipe, 15 in.	per ft.	2.25	1.80	1.85	.95
Sewer pipe, 18 in.	per ft.	3.00	2.50	2.45	1.50
Sewer pipe, 21 in.	per ft.	4.00	3.00		1.90
Sewer pipe, 24 in.	per ft.	6.00	4.50	3.75	3.10
Tile wall coping, 8 or 9 in	per ft.	.60	.50		.50
Tile wall coping, 12 or 13 in.	per ft.	.90	.75		.60
Flue lining, 8½ x 8½ in.	per ft.	.70	.60	.55	.40
Flue lining, 8½ x 13 in.	per ft.	1.00	.90	.65	.75
Chimney tops	each	9.00	3.50–5.00	7.50	4.50–6.00
Discounts		45 % truck lots	20 %		
		50 % car lots	50 %	5 %	

CEMENT:—*Discount of 10 cts. per bbl. in 20 days. Price f.o.b. cars is $3.75 †Subject to 5% discount. **Excluding bags.
LIME:—*Discount of 5%. †Bag of 50 lbs. **Price f.o.b. cars is $11.70.
BRICK AND TILE—*f.o.b. plant.
STONE SAND AND GRAVEL:—*Winnipeg prices subject to 5% disco **Toronto prices include sales tax.

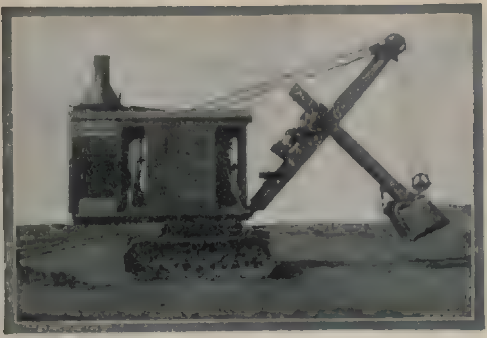
Climbing out of a Basement up a 20% Grade on Wet Slippery Clay

THIS SHOVEL IS DIFFERENT

"BUCYRUS" 20 B BULLSEYE

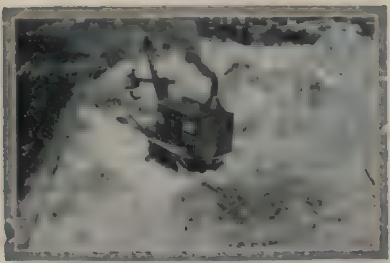
3/4 Yard Dipper

ON ROAD Wheels,
CAR Wheels or
CATERPILLAR TRACTION
POWER STEER FROM CAB
SUPERIOR TYPE OF CATERPILLARS
TWO PART HOIST LINE
THREE LEVER CONTROL



Send for Bulletin C2016 which describes the numerous exclusive features on this shovel
Convertible to Drag Line or Clamshell or ordinary Crane Work

Complete Line of
EXCAVATING MACHINERY, HOISTS, MIXERS, CRANES, LOCOMOTIVES, DUMP CARS, CRUSHERS, SCRAPERS, GRADERS, ROLLERS, ETC.



"She walked right in, turned right round and walked right out again"

MUSSENS LIMITED

Montreal Toronto Winnipeg Vancouver

CURRENT PRICES OF BUILDING AND ENGINEERING MATERIALS— continued

Lumber (Delivered on job):—		Toronto	Montreal	Winnipeg	Vancouver*
Flooring, 1 x 3 and 4 in., clear, E. G. fir	per M.	100.00	60.00	84.00	55.00
Flooring, 1 x 3 and 4 in., clear, F. G. fir	per M.	75.00	65.00	56.00	30.00
Flooring, No. 1 pine	per M.	70.00	80.00	64.80	
Flooring, No. 1 Spruce	per M.	45.00	40.00	39.60	
Flooring, birch and maple, 13/16 in. clear	per M.	130.00	110.00	152.00	200.00
Flooring, plain red oak, ⅜ in. clear	per M.	130.00	125.00	140.00	265.00
V joint, 1 x 3 and 4 in., Nos. 1 and 2, clear, fir	per M.	75.00	60.00	56.00	30.00
V joint, No. 1 pine	per M.	70.00	85.00	63.00	
Pine, 1 x 4 to 12 in., common rough	per M.	43–58	45.00	63.75	
Pine, 2 x 4 to 12 in., common rough	per M.	50/55	70.00	36.00	
Hemlock, 2 x 4 to 12 in.	per M.	40-42.00	40.00	36.00	11.50-18.75
Fir, 1 x 4 to 12 in. No. 1 common, D 1 S	per M.	40–50.00	50.00	36.00	11.00-13.50
Spruce, 1 and 2 x 4 to 12 in.	per M.	41/46	45–35	36.00	
Timbers, fir, 10 x 10 in. and up	per M.	65.00	58.00	47.00 base	17.-22.00
Lath, No. 1 white pine	per M.	14.00	12.00	12.00	
Lath, M. R. spruce	per M.	10.00	8.50	10.00	7.00
Shingles, XXX B.C. cedar	per M.	6.35	5.00	5.25	3.40
XX B.C. cedar	per M.	5.00	4.25	3.75	1.90
N.B. extras	per M.	6.50	6.75		
N.B. clears	per M.	6.00	5.50		
Pine casing	per M.	1 ct. per in.	95.00	108.00	55.00
Fir casing	per M.	1 ct. per in.	100.00	108.00	

PAINTS, OILS, COLOURS (delivered):—		Toronto	Montreal	Winnipeg	Vancouver*
White lead ground in oil, less than ton lots	per cwt.	14.00	13.35	14.85	15.80
Red lead, dry, small lots	per cwt.	17.00	9.55	22.00	22.00
Putty in bulk	per cwt.	6.70	3.75	5.50	9.25
Steel sash putty in bulk	per cwt.	7.20	6.00	8.75	7.75
Boiled linseed oil, in bbls.	per gal.	1.10	1.04	1.13	1.28
Raw linseed oil, in bbls.	per gal.	1.13	1.02	1.10	1.25
Turpentine, in bbls.	per gal.	2.15	1.95	2.15	1.60
Mortar Color, maroon, in bbls.	per lb.	.02¼		.06 4/5	6.45 per cwt.
Mortar Color, black, in bbls.	per lb.	.08		.06 1/5	.45

PLASTER (Delivered):—		Toronto	Montreal	Winnipeg	Vancouver*
Hard wall plaster, sanded	per ton	13.50	15.00	25.00	30.00
Plaster of paris, in bbl. lots	per bbl.	6.00	5.35	1.60 bag*	7.50
Plasterers' hair	per bag	2.50	7½ cts. per lb.	1.00 bu.	1.50

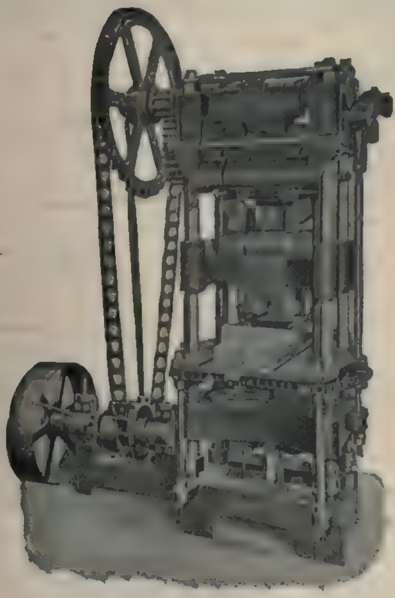
LABOR:—		Toronto	Montreal	Winnipeg	Vancouver*
Bricklayers	per hr.	1.00	.80–.90	1.15	1.06¼
Structural Iron Workers	per hr.	.85	.50–.75	1.25	1.00
Plasterers	per hr.	1.00	.80	1.05	1.06¼
Hoisting Engineers	per hr.	.70–.80	.50	.90–1.10	1.00
Plumbers	per hr.	.90	.60–.75	1.00	.90
Carpenters	per hr.	.80	.65	.90	.81¼
Painters	per hr.	.75	.55–.65	.80	.81¼
Electrical Workers	per hr.	.80	.65	.70– .90	1.00
Roofers	per hr.	.65	.65		.90
Laborers	per hr.	.40–.50	.30	47½–.55	.50–.56¼
Sheet Metal Workers	per hr.	.75			.90

LUMBER:—*Owing to the general unstable condition of the present lumber market, Vancouver dealers refuse to quote any prices at all especially for Prairie or Eastern publication. The prices are, moreover, fluctuating from day to day. Such prices as we quote are, therefore, averages and not standard.
PLASTER *Including bags.

Hamilton-Galt
Provincial Highway

Provincial Contracting Company Limited
General Contractors
24 Adelaide Street West
TORONTO

Wettlaufer Brick Presses and Mixers



Power Brick Press

—the recognized standard of the industry

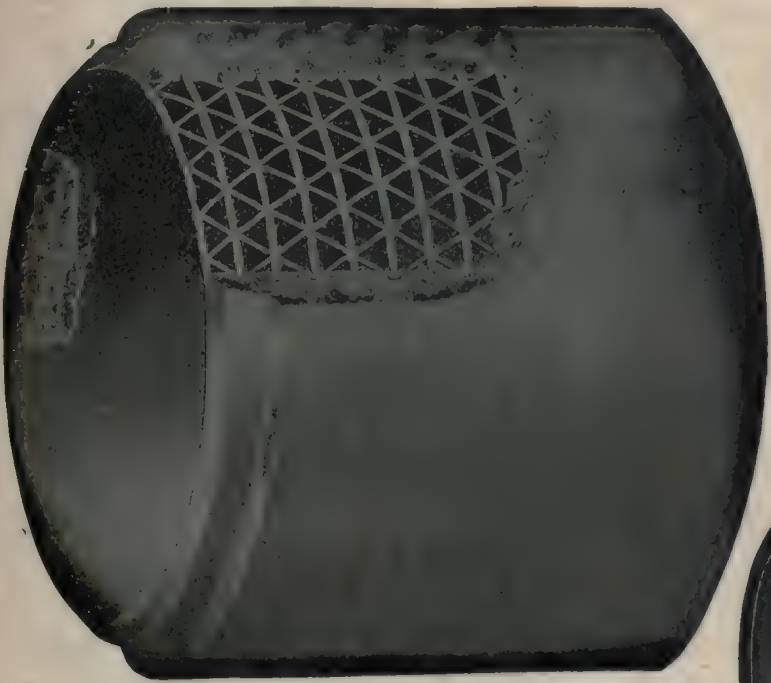
CONCRETE AND ROAD MACHINERY

Crushers, Hoists, Rolls, Pavers, Loaders, Graders, Brick, Block, Tile, Sewer Pipe Machines, Etc.

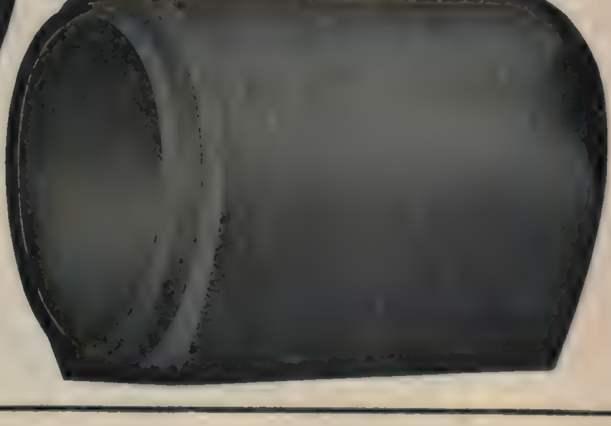
Made in Canada

Write for our latest Catalogue.

Wettlaufer Bros. Ltd.
178 Spadina Ave., Toronto



Sewers
and
Culverts
built from
Our Concrete
give maximum service
at minimum cost
(LARGE STOCK ON HAND



Write us for Catalogue and Prices

Dominion Concrete Co. Limited
KEMPTVILLE - ONTARIO

E. G. M. CAPE & CO.

Engineers and Contractors

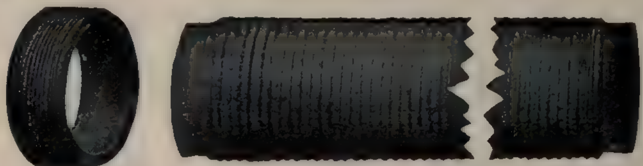
Estimates and Tenders Furnished on all classes of Construction Work

General Building Construction

Head Office:

920 NEW BIRKS BLDG. PHILLIPS SQUARE

MONTREAL



Pacific Coast Pipe Co., Ltd.

Wire Wound Wood Stave Pipe

from 2 in. to 24 in. diameter

Continuous Stave Pipe

from 16 in. to 12 ft. diameter

1551 Granville Street - Vancouver, B.C.

VINCENT'S Prepared Tracing Papers

Superior Tracing Papers

"Vellum" No. V-110 Cream Tint, "Vellum" No. V-120 Natural Tint, "Veltex" No. V-140 Blue Tint.

NOT AFFECTED BY WATER OR VARYING ATMOSPHERIC CONDITIONS

and therefore superior to tracing cloth, as drawings to scale remain accurate indefinitely.

INK, PENCIL, CRAYON, OR WATERCOLORS MAY BE USED

Fast, sharp prints by any process.

A heavy, strong, and exceptionally transparent paper

UNEQUALLED FOR ERASING

Does not deteriorate with age and will not become brittle. Supplied in rolls on large diameter cores, so that it will lie flat on the board. Sheets cut to order.

ORDER THROUGH YOUR DEALER

Samples on request from the manufacturer

GEORGE VINCENT

49 West 43rd St. NEW YORK CITY

Asbestos Fibre

—LIQUID—

Roof Cement

Protect your roofs against the ravages of the weather by coating them with this specially prepared waterproof, acidproof and rustproof product. It is adapted to all metal, felt, rubber or gravel roofs and sidings. Comes in black, red and green color, ready for use. Easily applied. Will not run.

Asbestos Fibre

—PLASTIC—

Roof Cement

is an ideal material for weather-proofing old and leaky roofs of every type. It is economical, easily applied and lengthens the life of the roof. Also adapted to water—and damp-proofing basements and concrete walls, sealing leaks in gutters, culverts, drains, boat bottoms, etc. Special prices to contractors.

Write for particulars.

The R. W. DAVIDSON Co.

PETERBOROUGH, ONT.

CLIMBS GRADE as steep as 30 per cent. (engineer's measurement). POWER STEERING from the cab. No man needed on the ground. COMPLETE LUBRICATION which gives greater speed and more power.

A RELIABLE Caterpillar type Steam Shovel

Excavating men tell us "It is the greatest improvement in excavating machinery in the past 10 years." We'll be glad to send you more information about the Erie caterpillar type mounting. Just write for Bulletin C-60.
Erie Steam Shovel Co., Erie Pa., U.S.A.

Moves over soft and muddy ground without planking.

ERIE Revolving Shovels

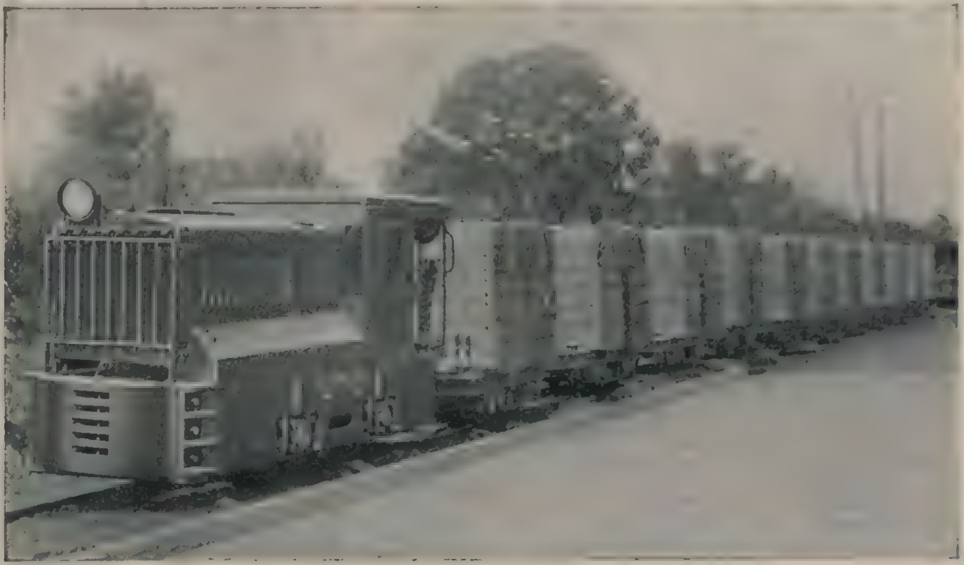
ERIE Steam Shovel Co.

Tenders

A few dollars spent in advertising your proposals in the

Contract Record
and Engineering Review

would result in additional competition which might save your city or town or your client many hundreds of dollars



One of the 3 Plymouth Gear Drive Locomotives owned by Carpenter Construction Co., Terre Haute, Ind.

Announcing the Plymouth 4 Speed Gear Drive Gasoline Locomotive

No part of an Industrial Locomotive is of more vital importance than its Transmission. No matter how good or powerful the Engine or Power Plant all power must be transmitted through the Transmission. It can be either the strongest or weakest link.

When we designed the 7 ton, 4 speed, Plymouth Gear Drive Locomotive we gave the Transmission our first consideration. We have spent years in the study and experiment of transmissions. Not until after long, hard and grueling tests in actual road work—tests that showed this Locomotive would develop and maintain a drawbar pull of 5250 lbs. on sanded rail—were we satisfied with this Transmission.

There must be reasons for this remarkable performance. There are.

1. **Transmission has exclusive feature of a final driving gear and shaft housed in the gear case compounding the ratio of the other gears.**
2. **All gears unusually large and massive, final driving gear being 14½" in diameter by 4" face. Other gears 2" and 2¼" face of large diameter.**
3. **All Gears made of alloy hardened steel, mounted on extra heavy shafting and ball bearings.**
4. **Gears that are driving are the only ones in mesh.**
5. **No Jack Shaft required.**
6. **No Jaw Clutches.**
7. **Driving Sprockets on same horizontal plane with axles.**
8. **Only two short Drive Chains—both extra heavy.**
9. **All Ball Bearings inside of Gear Case, from which they are lubricated.**
10. **Clutch has nine driving discs faced on each side with non-burnable facings. Very smooth in action.**

Plymouth Gear Drive Locomotives are not an experiment. They have been tried, tested and proved. They are at work in road construction, quarries, sand and gravel pits and industrial plants—and the numerous repeat orders attest the exceptional service.

See the Plymouth Gear Drive at the Good Roads Show, Chicago—Jan. 15-20—or write for literature.

The Fate-Root-Heath Company

Plymouth, :-: Ohio

Structural Steel and Bridges

We build and erect all kinds of Structural Steel Bridges, Roof Trusses, Bank and Office Railings, Stair Work, Elevator Grilles, Fire Escapes, etc.

Over 5,000 Tons in Stock of Beams, Column Sections, Angles, Tees, Plates, Bars, Checkered Floor Plates, etc.

Annual Capacity 18,000 Tons

Building No. 10 of the Plant of Durant Motors of Canada Ltd., at Leaside, Ont., measuring 501 feet by 130 feet.

McGregor & McIntyre, Limited

1139 Shaw Street
TORONTO, CAN.

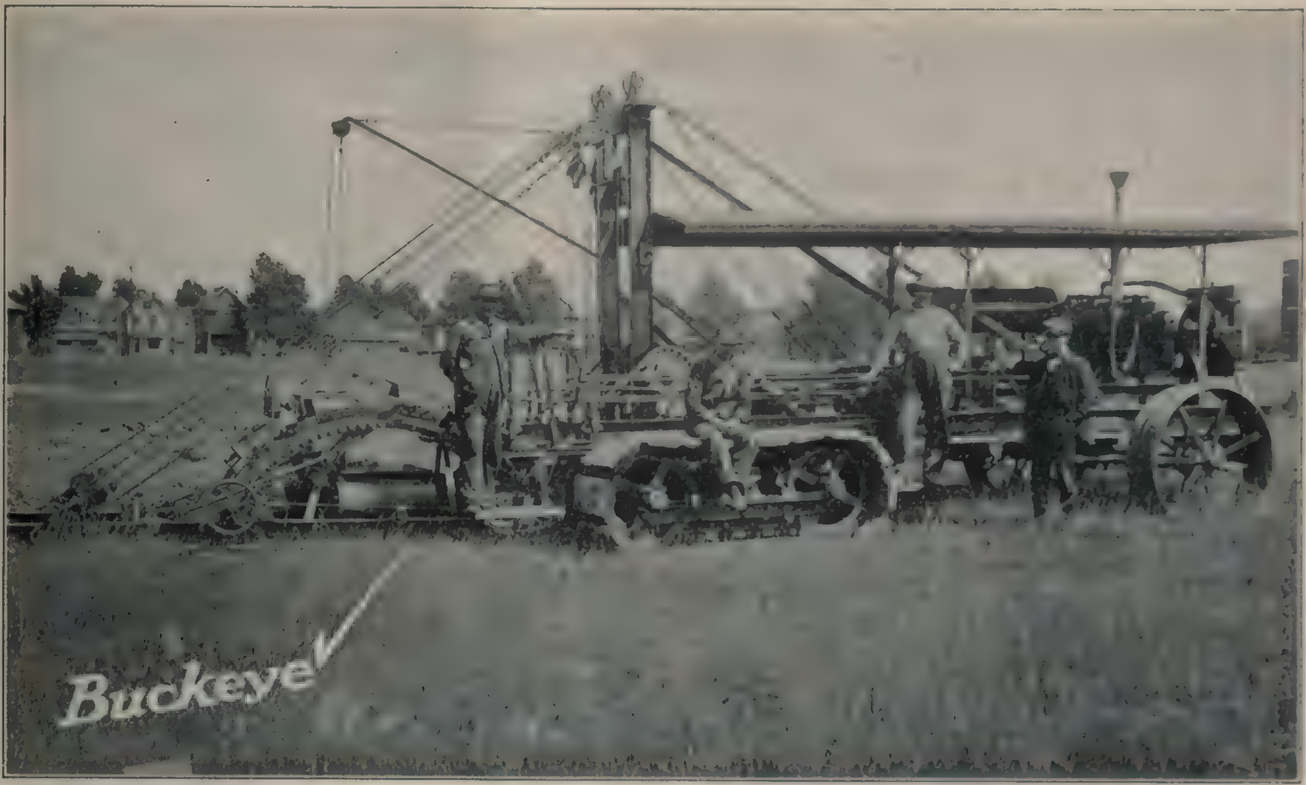
Lowest Rate per Interested Reader

Direct your advertising to the real buyers—the readers of business and technical publications. When you advertise, do you appeal to single purchase customers or to the merchant or jobber who buys in quantities? It is cheaper to reach the quantity buyer than the single purchase customer because we publish business papers with the lowest rate per interested reader.

Hugh C. MacLean Publications

Electrical News, Contract Record and Engineering Review, Canada Lumberman, Canadian Woodworker, Footwear in Canada, Commercial and Retail Merchants' Review, Furniture World, Western Lumberman, Western Canada Coal Review, Western Canada Contractor and Builder.

VANCOUVER WINNIPEG TORONTO MONTREAL CHICAGO NEW YORK



"Very Pleased with the Results"—

Says City Engineer of Hamilton, Ont.

"Very pleased with the results it has given. It is a great saver over hand labor," says E. R. Gray, City Engineer of Hamilton, Ont.

His Buckeye 4-A will dig more ditch than 50 men, anywhere—any time. No "off" days—no complaints. Buckeyes just work and **work**, steadily and at low cost.

For 18, 21 and 24 inch trench up to 6½ feet deep you can't beat a Buckeye 4-A for big yardage at low cost. Other sizes and types for every use.

Let us show you how Buckeyes will save for **you.**

Send for the Buckeye Bulletins.

Buckeye Owners Say:

"During the season we dug 40,000 feet of trench 24" wide and 5½ feet deep and we felt that the machine had paid for itself after 30,000 ft."—Commissioner Johnson, of Saginaw, Mich.

Used his Buckeye for two years. Repair cost less than $175, and the Buckeye is as good as new—Clem E. Ratcliff, Kingman, Ind.

"With good digging free from stone and boulders our Buckeye would dig as much as 60 men. With the soil we have we figure it will average 25 men. We dig in clay, shale, gravel and macadam roads."—City of Syracuse, N.Y., Bureau of Water.

You, too, can save with a
Buckeye
Let us show you how

The Buckeye Traction Ditcher Co.

Manufacturers of Trench Excavators (both Wheel and Chain-and Bucket Types), Concrete Breakers, Pipe Line Trench Excavators, Tile and Open Ditchers, Back Fillers, Pipe Screwing Machines, Curb Diggers and Clay Diggers.

Findlay, Ohio

Branch Sales and Service Office:
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Chatham, Ontario

Sales Representative:
The General Supply Company of Canada, Ltd.,
85 Water Street, Winnipeg, Manitoba

Buckeye

BENEDICT STONE

Mount Royal Hotel, Montreal
Ross and Macdonald, Architects

Canada Cement Company Building, Montreal
Barrott and Blackader, Architects

Medical Arts Building, Montreal
Ross and Macdonald, Architects

CANADIAN BENEDICT STONE, LIMITED
Canada Cement Company Building, Phillips Square, Montreal

Reinforcing

BARS

Rounds **Squares** **Twisted**

We carry stock of all lengths and can make prompt shipments.

also

Bolts **Nuts** **Rivets** **Wire** **Wire Nails**

Canadian Tube & Steel Products, Limited
Works: Lachine Canal, MONTREAL

Building Tile
Field and Drain Tile

Famous Denison load bearing everlasting Tile at money saving prices any season of the year.

Erie Clay Products, Ltd.
Box 810
Simcoe - Ont.
Toronto Representative:
H. A. J. Aldington,
Manning Arcade

DEPARTMENT OF LABOUR

BOILER INSPECTION NOTICE

Excerpt from Regulations for the Construction and Inspection of Boilers

Section 300

No Boiler which has been in use for two or more seasons shall be sold or exchanged for subsequent use as a Boiler unless it is accompanied by an inspection certificate issued by the Department within one year preceding the date of such sale or exchange. The allowable working pressure for such Boiler shall be determined by the Inspector from the formulæ contained in the regulations, with such deductions in pressure for depreciation as the Inspector's judgment shall dictate.

The travelling expenses in connection with the inspection of Boilers sold, exchanged or extensively repaired, must be paid by the owner or purchaser of such Boilers, together with the inspection fee of five dollars.

All communications should be addressed to the Steam Boiler Branch, Department of Labour, Spadina Crescent.

HON. W. R. ROLLO,
Minister of Labour.

D. M. MEDCALF, Chief Inspector of Steam Boilers.

Cyclone Churn Drills

For Blast Hole, Water, Shallow Oil and Gas Well Drillling and Mineral Testing

The No. 14 Cyclone Blast Hole Drill is a machine especially designed and constructed for drilling blast holes in quarries, open pit mines and for heavy rock excavation. Built in two sizes in both traction and non traction types with gasoline, electric or steam power. Covered in our Catalog B-45.

Cyclone Well Drills are built in 5 sizes, capacities 200 to 2000 feet and in both traction and non traction types with gasoline or steam power. Will operate cable and hollow rod drilling tools, the latter by either the self-pumping or jetting process. Well Drills are described in our Catalog A-70.

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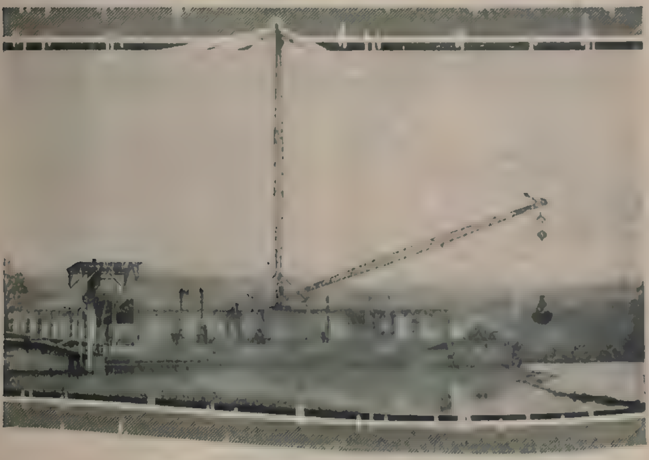

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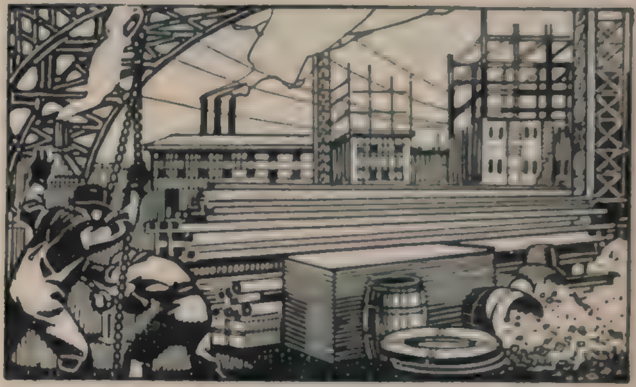

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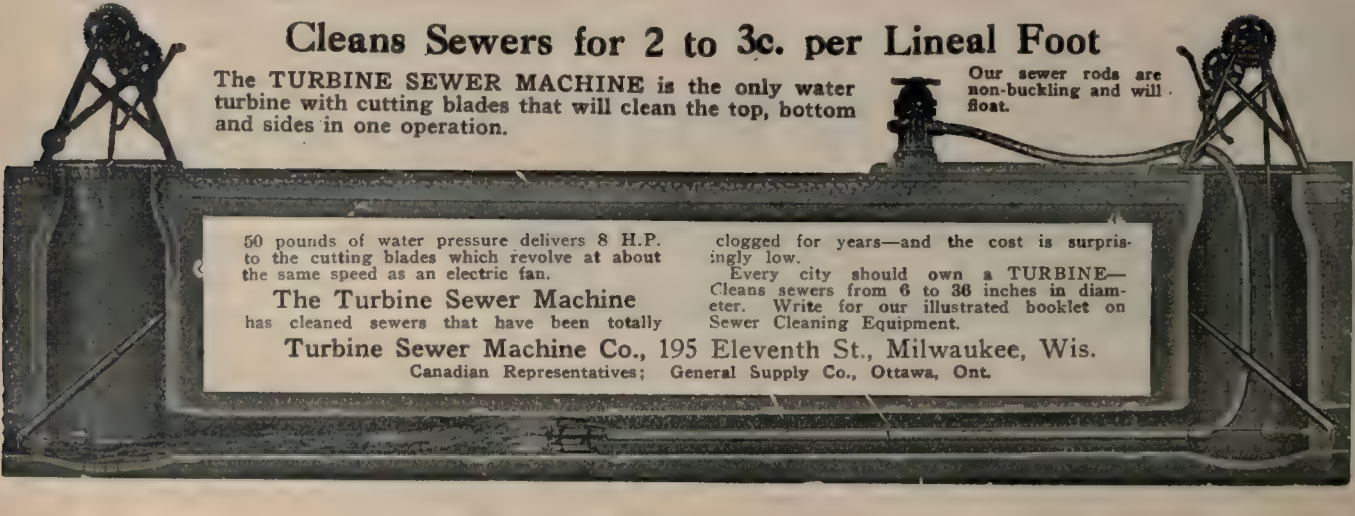

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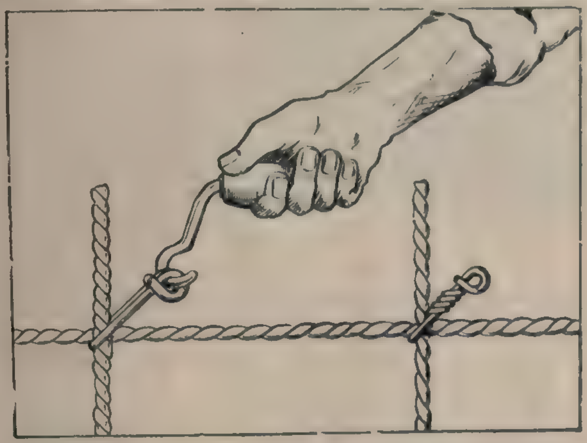

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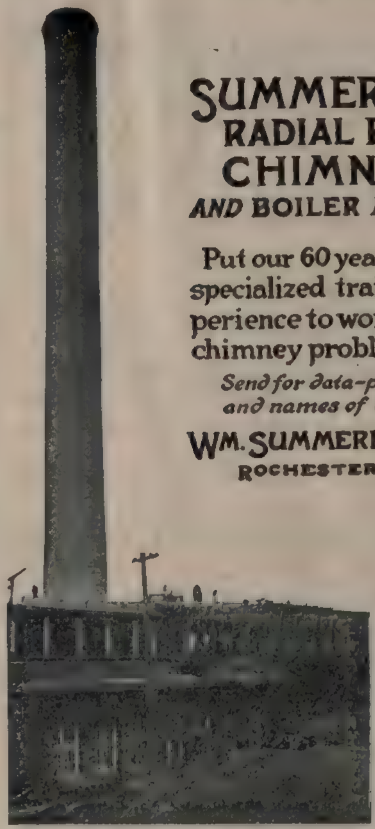

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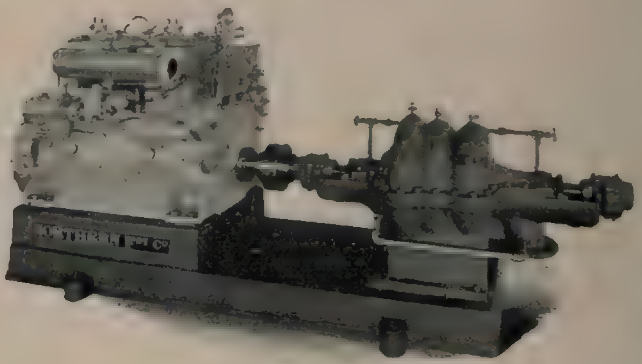

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